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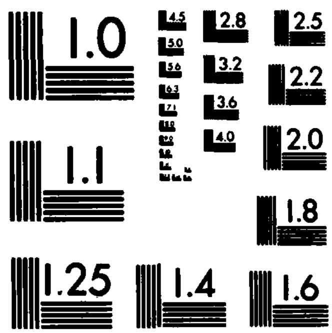

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FINAL REPORT ON INFRARED MEASUREMENTS OF AFGL SOURCES

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We report infrared positions and multicolor infrared photometry for a sample of type II OH/IR stars. The infrared colors and 11.4 μm silicate optical depths of the low-latitude sources in this group increase as a function of distance, suggesting that interstellar reddening must be taken into account in assessing their infrared energy distributions. Reddening gradients between 1 and 3 times higher than the mean gradient in the direction of the galactic center are required to account for the observed color-distance correlation, a fact

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) which might be explained by these stars' confinement to spiral arms.

The noise limited magnitudes for the AFGL Infrared Sky Survey have been estimated by direct comparison with ground based observations. Using these limiting magnitudes pruned versions of the AFGL catalog have been generated. Infrared observations of all the stellar objects seen at 11, 20 or 27 μm and a statistical sample of the stars seen only at 4 μm are reported. Analysis of the observations leads to estimates of the absolute 4 and 10 μm magnitudes and space densities for the two classes of objects. The expected results from the Infrared Astronomical Satellite are re-examined.

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The Stellar Component of the Galaxy As Seen by the AFGL Infrared Sky Survey

by

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Abstract

The noise limited magnitudes for the AFGL Infrared Sky Survey have been estimated by direct comparison with ground based observations. Using these limiting magnitudes pruned versions of the AFGL catalog have been generated. Infrared observations of all the stellar objects seen at 11, 20 or 27 μm and a statistical sample of the stars seen only at 4 μm are reported. Analysis of the observations leads to estimates of the absolute 4 and 10 μm magnitudes and space densities for the two classes of objects. The expected results from the Infrared Astronomical Satellite are re-examined.

Key words; Infrared: sources, Stars; catalogs, circumstellar shells.

I. INTRODUCTION

A highly developed statistical understanding of the contents of the visible universe has emerged from intense study of the Palomar Observatory Sky Survey over the last three decades. Numerous radio surveys have given us nearly as complete an understanding of the radio universe. By comparison our current knowledge of the infrared contents of our galaxy is poor. However the Infrared Astronomical Satellite (IRAS) is expected to find approximately 10^6 new infrared sources. Fresh insight into the makeup of the infrared sky is essential if interesting populations of new objects are to be culled from among these 10^6 sources and if large numbers of stars from relatively well understood populations are to be rejected.

Currently, the only all-sky infrared survey from which to study the infrared populations in the universe at wavelengths longer than 2 μm is the Air Force Geophysical Laboratory (AFGL) 4, 11, 20 and 27 μm survey (Walker and Price, 1975; and Price and Walker, 1976). Gehrz and Hackwell (1976), Gosnell, Hudsen, and Puetter (1979), Kleinmann et al. (1979), Lebofsky et al. (1976), Lebofsky et al (1978) and Low et al. (1976) have presented further infrared data confirming AFGL survey sources and delineating the statistical accuracy of the AFGL catalog. A consistent theme of these observational papers is that a large fraction of the reported AFGL survey sources cannot be confirmed by ground based observations. In particular the papers by the Arizona group have concentrated on the "new" AFGL sources, that is sources not identified with previously known objects. For this special class of objects they derive a confirmation rate of only 60% (Lebofsky et al 1978). It is remarkable that this poor rate of confirmation has not led to a more careful examination of the sources identified with known objects. It seems clear that until the AFGL sources are verified from gound based observations statistical analyses based solely on the AFGL catalog (Lebofsky et al 1978 and Kleinmann, Gillett and Joyce 1981) are highly suspect.

Several authors have performed limited statistical analyses of the contents of the mid-infrared sky using the AFGL survey. Harris and Rowan-Robinson (1977), from a sample of 216 sources, concluded that surveys at 4 μm detect almost exclusively the red giant population of the galaxy. They also found that longer wavelength infrared surveys are dominated by stars with circumstellar shells and by HII regions. A drawback to their analysis is that it relies on a highly non-uniform data set compiled from observations made by many different observers who used a variety of telescopes and photometric techniques. Lebofsky et al. (1978) and Kelinmann et al (1981) derived a picture of the 11 μm sky which was broadly consistent with that obtained by Harris and Rowan-Robinson.

The Wyoming infrared group has for the past five years been engaged in an effort, along with groups at the University of Minnesota and the University of California at San Diego, to obtain complete infrared photometry of all the sources in the AFGL catalog. Each research group was assigned approximately one third of the sources in the AFGL catalog by dividing the catalog into three right ascension zones. The Wyoming Infrared Observatory (WIRO) zone includes sources in the 20 to 40 minute interval for each hour of right ascension. Rudy, Gosnell, and Willner (1979), Gehrz, Hackwell, and Grasdalen (1980), and Ney and Merrill (1980) have reported preliminary results of portions of the survey.

We report in this paper an analysis of the stellar populations in the mid-infrared sky based upon infrared photometry of AFGL sources in the WIRO zone. All sources associated with HII regions, extended sources, and external galaxies have not been considered in the present analysis; these results will be reported separately. The ultimate objective of this segment of the WIRO survey was to use a completely uniform and unbiased data set to develop a statistical picture of that stellar population of our galaxy which dominates the mid-infrared sky.

II. THE OBSERVATIONS

The infrared photometric data obtained during this survey are given in Tables 1, 2, and 3. All photometry was performed using the standard Wyoming multifilter infrared photometer equipped with Helium cooled Ga-Ge bolometers constructed at the University of Wyoming. Effective wavelengths, bandpasses, and magnitudes for standard stars and absolute calibrations for the 2.3-19.5 μm filter sets have been reported by Gehrz, Hackwell and Jones (1974). An additional filter with an effective wavelength at 23 μm has been added to the standard set and this filter was calibrated by assuming that the [19.5] - [23] color of all the standard stars was zero. Most of the measurements were made with the 234 cm telescope of the University of Wyoming Infrared Observatory. However, measurements made prior to 1977 November 1 were made either with the 127 cm and 213 cm telescopes at Kitt Peak National Observatory or the 152 cm telescope at the Mt. Lemmon Infrared Observatory operated by the University of Minnesota and the University of California at San Diego.

III Limits of the WIRO Survey

Initially the plan of the WIRO observations was to obtain photometry of the entire WIRO zone (20-40 minute interval for each hour of right ascension) of the AFGL catalog north of declination -35°. This would result in a fairly random selection of sources for observation. Analysis of the preliminary results indicated that the reliability limit of the AFGL catalog was at a substantially brighter level than the limiting magnitude of the catalog. This is demonstrated in Figures 1 and 2, where the WIRO magnitudes have been plotted against the AFGL catalog values. For the purpose of comparing the WIRO observations with the AFGL magnitudes at 4 μm, the 3.5 μm and 4.9 μm WIRO magnitudes were averaged. In general these plots show a tight, nearly linear relation between the rocket and ground based observations. However, fainter than about 0 magnitudes for the 4 μm plot and about -2 magnitudes for the 11 μm plot, these correlations become much wider. This behavior is convincing evidence that the rocket measurements are inaccurate at low flux levels. Other phenomena cannot account for the scatter. Variability of the sources would produce a uniform broadening of the relation. Extended sources would be much fainter in the small angular aperture used for the ground based measurements and would produce a fringe of points to the left of the tight correlation. Both of these phenomena may be present in the plots, but not at sufficient levels to explain the large scatter at faint rocket magnitudes.

The appearance of figures 1 and 2 can be modeled by assuming the noise in the rocket measurements has a constant value in flux units: i.e. the noise is independent of signal level. The figures show lines which correspond to adding and subtracting a constant flux value from the observed rocket flux. The noise constant has been taken as equivalent to an 11 μm magnitude of -0.8 and a 4 μm magnitude of +2.2. A similar analysis of the more limited 20 μm data implies the noise magnitude at this wavelength to be about -3.3. It is encouraging that the observed distributions are fit well by this simple noise model.

This analysis has provided us an estimate of the noise present in the verified photometric measurements reported in the AFGL catalog. It is more difficult to translate this into an estimate of the reliability limit of the survey. The limits used to sift out objects from the catalog for further study were arbitrarily set twice as large as the apparent noise levels and were taken as +1.3 at 4 μm, -1.5 at 11 μm and -4.0 at 20 μm. Because these limits were chosen before all the WIRO survey data was in hand, they are somewhat different from those given by the more complete data in figures 1 and 2. These reliability limits are not the same as completeness limits derived from source counts. We have not examined any expected behavior of the number of sources as a function of magnitude to derive these limits; they refer only to the mean photometric accuracy in the AFGL catalog. This is an essential step in any statistical study. Kelinmann et al (1981) derive a completeness limit for the AFGL survey based on the expected shape of the log N-magnitude relation. Since they have not made ground based observations to verify the existance of these sources as a function of magnitude their completeness limit has no physical meaning. It is entirely conceivable that all the sources at their limit are spurious. All that would be required is that the noise distribution mimic the expected log N-magnitude relation.

The object of deriving revised limiting magnitudes was to avoid spending large amounts of telescope time searching for sources which were not reliably measured by the AFGL survey. Eliminating sources with observed magnitudes below the revised limits resulted in removing 173 of the 739 entries in the WIRO zone. Of the 173 sources only 57 had 11 μm measurements; thus only a small number of the reported 11 μm sources were entirely eliminated from the WIRO survey. It should be emphasized that many of the eliminated catalog entries are bona fide sources. Our efforts were aimed at producing a manageable statistical sample that might prove to be reasonably complete.

The major effect of pruning the catalog was to eliminate 11 μm or 20 μm observations of sources seen reliably at 4 μm. This means that the number of 11 μm sources to be sought has been significantly reduced, and that only a small fraction of the catalog entries have been reliably detected at 11, 20 or 27 μm. The AFGL catalog is dominated by observations of sources seen at 4 μm only. Thus, the pruned catalog was divided into two catagories; long lambda (LL) sources, seen at 11, 20, or 27 μm, and four micron only (FMO), sources seen reliably only at 4 μm. The rejected sources are referred to as the lost (LST) sources. There are 164 LL, 402 FMO and 173 LST sources in the WIRO zone of the AFGL catalog.

Our goal was to measure every possible LL source in the WIRO Zone, but complete photometry of the entire FMO group would have taken a prohibitively long time to complete. Thus we chose a statistically unbiased set of the FMO objects by selecting every eighth FMO entry as a candidate for photometry. This resulted in a group of 49 catalog entries named the WIRO 49 (W49). In summary our plan was to: (1) verify the reality of every LL and W49 source and (2) obtain infrared photometry of all of the verified sources.

IV The Tabulations

The results of our observations are given in Tables 1, 2 and 3. In our preparations for observing we found it very time consuming to gather all of the available information for the AFGL catalog entries. We have therefore decided to reproduce in a single place much of the relevant information about the sources regardless of whether we observed each source or not. Explanations of the columns in Tables 1, 2 and 3 as well as the sources of information are given below.

IRC: The number assigned in the Infrared Catalog (IRC) of Neugebauer and Leighton (1969) to the source cross identified by the AFGL catalog with the AFGL entry.

HR: The number in the Harvard Revised catalog (usually today taken from the Yale Catalog of Bright Stars, Hoffleit, (1964)).

BD: The Bonner Durchmusterung catalog number. (Taken from secondary listings; we did not do a recomparison of the AFGL with the BD).

OTHER: Here we report other names for the source: Flamsteed designations, variable star designations, stars suspected of variability, numbers from the Albany General Catalog (Boss 1937), prominent radio designations or descriptive comments. We attempted to choose the most relevant name; many stars are entered in several of these lists, but it hardly seems relevant to report all the designations.

TYPE: Here we have reproduced the variability type from the. General Catalog of Variable Stars (GCVS) [Kukarkin et al. (1969), Kukarkin et al. (1970), Kukarkin et al. (1971), and Kukarkin et al. (1976)].

PERIOD: Period of variability from the GCVS.

SP TYPE: This is our judgement of the most accurate spectral type available for the source.

SOURCE: This gives an abbreviation for the source of the spectral type.

DO	The Dearborn Catalog of Faint Red Stars [Lee et al.(1943), Lee et al. (1944), and Lee et al. (1947)]
IRC	IRC.
GCVS	GCVS.
VOGT	Vogt (1973).
H&B	Hansen and Blanco (1975).
LWD	Lockwood (1974).
HR	Yale Catalog of Bright Stars. [Hoffleit, (1964].
CK1	Cohen and Kuhi (1976).
CK2	Cohen and Kuhi (1977).
GC	General Catalog [Boss (1937)].
CASE	Case surveys for late type stars. [Nassau and Blanco (1954a), Nassau and Blanco (1954b), Nassau et al. (1954), Nassau et al. (1956), and Blanco and Nassau (1957)]
WWSJ	Wisnienski et al. (1967).

H&L Harvey and Lada (1980).

GHB Gehrz et al. (1978).

HBG Herbig (1956).

LUM The luminosity class as coded by;

2 = Luminosity Class I and II

3 = Luminosity Class III

4 = Luminosity Class IV

5 = Luminosity Class V

6 = Luminosity Class c

7 = Luminosity Class g

8 = Luminosity Class d

RA & Dec. The 1950 position for the source. Here again we attempted to reproduce the position from the best available source. The sources used are as follows:

SAO *The Smithsonian Astrophysical Observatory Catalog of Positions for 1950.0*.

JYCE Joyce et al. (1977).

G&H Gehrz and Hackwell (1976) (including unpublished positions).

WIRO Positions determined at the Wyoming Infrared Observatory.

GCVS *General Catalog of Variable Stars*.

SVS *Catalog of Suspected Variable Stars*.

IRC *Infrared Catalog*, Neugebauer & Leighton (1969).

LADA Lada et al. (1981).

GC *General Catalog*, Boss (1937).

AGK3	Catalog der Astronomischen Gesellschaft, Dieckvoss (1962).
LKVR	Low et al. (1976).
LKRL	Lebofsky et al. (1978).
KLMN	Kleinmann et al. (1979).
AFGL	The position from the AFGL Catalog.
GLG	Grasdalen (1974)
RIED	Ried et al. (1980)
SSJ	Simon et al. (1979)
BHR	Baldwin et al. (1973)
HGSB	Hackwell et al. (1978)
HGG	Hackwell et al. (1982)
LSKR	Lebofsky et al. (1978)

Comment	A letter C in this column means that a comment about the source exists in Table 4.
V and Source	Visual magnitude or in the case of data from the Dearborn Catalog of Faint Red Stars. (Lee et al. 1943, Lee et al. 1944, and Lee et al. 1947) and Joyce et al. (1977) the red magnitude, and the source of the information.
I' and K	Magnitudes from the IRC, I' refers to a photometric band centered at 0.7μm. Asterisks denote saturated signals.
4, 11, 20 and 27	The magnitudes reported in the AFGL Catalog.
D/M/Y	The date of any WIRO observations.
2.3 - 23.0	The observed magnitudes. The photometric

system was identical to that described by Gehrz, Hackwell, and Jones (1974).

OBSVR — The initials of the observer.

GG = Gary Grasdalen

JAH = John Hackwell

RDG = Robert D. Gehrz

BTA = Dan Briotta

G&H = Gehrz and Hackwell (1976)(and additional unpublished data).

Inspection of tables 1, 2, and 3 indicate we have come close to our goals. The survey of LL Sources is very nearly complete. Many of the LL Sources that do not have reported magnitudes are associated with well known dark clouds or HII regions. These associations are reported in Table 5. A listing of those LL sources that we deem to be spurious is given in Table 6. The only entry without photometry which is not present in tables 5 and 6 is GL 4250.

V. Discussion

a. The Completeness of the AFGL Survey

To assess the completeness limits of the AFGL survey we have formed the integral source counts as a function of the 4 and 10 μm magnitudes. These counts are based, for the first time, on a uniform sample of sources verified by ground based observations. The logarithm of the number of sources brighter than magnitude [λ] is plotted against [λ] in figures 3 and 4. The LL source counts are plotted as dots in these two figures.

From these figures we see that the [10] counts exhibit a break in slope between [10] = -1 and -2. This corresponds quite closely to the adopted reliability limit of the AFGL catalog (see § III). Because of the small number in the sample the estimate of the slope of the count-magnitude relation is rather uncertain. The line drawn on figure 3 has a slope of 0.6, the expected slope for a sample of uniform density: a slope as low as 0.4 is ruled out by the data. We conclude that the sample is very nearly uniformly complete down to [10] = -1.5. At [10] a slope of 0.6 predicts 74 sources brighter than [10] = -1.5 in our sample. Thus, for the sky north of declination -30°, we would expect 220 sources brighter than [10] = -1.5. This estimate is a lower limit; some sources may have been missed. Because of the way in which the survey was done, we would not expect the missed sources to be solely the faint ones, that would badly skew the count-magnitude relation. Rather we would expect certain areas of the sky to be incompletely sampled.

The [4] counts of the LL Sources (figure 4) exhibit a break in slope between [4] = -0.5 and +0.5. The WIRO 49 sample has been used to extend the counts to fainter limiting magnitudes by multiplying the W49 sample counts by 8 and adding them to the LL sample. The results are plotted as x's in figures 3 and 4. Not unexpectedly the W49 counts extend the [4] counts smoothly through [4] = +1, there is only a marginal change of slope as the counts reach +2. The slope of the [4] count-magnitude relation is 0.54, close to the value of 0.6 expected from a uniform density sample. At [4] = +1.3 the straight line gives the total number of sources as 282. Thus the total number of 4μm sources north of declination -30° is expected to be 850.

It is interesting to compare the number of 4 μm sources to the number of 2.2μm or K magnitude sources from the IRC. The IRC is thought to be a complete sample to K = + 2.8. Extrapolating the [4] count-magnitude relation to [4] = + 2.8 we obtain an expected number of 5500 sources, remarkably close to the observed number of 5612 IRC 2.2 μm sources. Because the K - [4] color of almost all normal stars is between 0.0 and -0.5, this result 1) confirms our expectation that a survey at 4 μm would include all sources seen to comparable magnitude limits at 2.2 μm and 2) demonstrates that the survey at 4 μm contains few sources not previously seen at 2.2 μm. This conclusion is further bolstered by noting that 88% of the FMO sources are cross-identified with IRC entries. Thus, at flux levels brighter than about 2 magnitudes the sky does not appear to change substantially between 2.2 and 4 μm, down to an apparent magnitude of +2.

The [10] distribution for the WIRO 49 begins at [10] = -0.5 (figure 4). This result could have been implied from the magnitude reliability results of § III which predict that very few of the FMO entries should be strong sources at 10 μm. Thus the FMO objects are not strong 10 μm sources in contrast to the results expected on the basis of the 11 μm magnitudes reported in the AFGL catalog. When the [10] count-magnitude relation of figure 4 is extended using the W49 sample we find that it continues to fall substantially below the extrapolation of the brighter counts. We conclude that surveys at wavelengths of 4 μm or shorter must be extended to much fainter limiting magnitudes than the AFGL or IRC if they are to extend significantly the 10 μm sample.

To illustrate further the difference between the magnitude limited surveys at 4 and 10 μm we have plotted in figure 5 the distribution of the [4] - [10] colors for the magnitude limited samples of the [4] and [10] sources. The sources in figure 5 were taken entirely from the LL list; the upper panel contains these sources brighter than -1.5 at 10 μm, the lower panel those brighter than -0.1 at 4μm. The two samples have dramatically different [4] - [10] color distributions. The 4 μm sample is dominated by sources with [4] - [10] colors ≅ 1.0, while the 10 μm sample has a broad distribution which extends to [4] - [10] = 6 and has a median value of [4] - [10] = 1.9. Thus, to extend even approximately the [10] counts, we would have to survey at least 4 magnitudes fainter at 4 μm than at 10 μm. Therefore, a magnitude limited sample at 10 μm produces an entirely distinct source list from a 2 μm or a 4 μm survey, and the appearance of the sky undergoes a dramatic transformation between 4 μm and 11 μm.

The most likely explanation of the large [4] - [10] colors is that the 10 μm radiation is principally from circumstellar dust. To explain these large colors as being due to interstellar extinction is totally implausible. The infrared extinctions would be much too large. Thus, we conclude that the 10 μm sample is entirely dominated by stars with extreme circumstellar dust shells. This is very important because surveys to fainter limiting magnitudes will continue to exhibit this pattern until the limiting distance of the survey extends beyond the physical limit of the galaxy. Therefore the critical factor in evaluating the appearance of the infrared sky at limiting magnitudes fainter than -1.5 is the absolute magnitude of the 10 μm sources detected by the AFGL survey.

b. Mean Absolute Magnitudes from the Galactic Distributions

By assuming the absolute distribution of the objects detected by the AFGL survey in the direction perpendicular to the galactic plane, we can use the observed distribution of the sources in galactic latitude as a measure of the absolute magnitudes of the sources. Figure 6 plots the [4] and [10] latitude distributions of the magnitude limited sample after correcting to refer to the entire sky. In order to model these distributions we have assumed an exponential density distribution in the z direction:

$$N(z) = N_0 \exp(-z/\beta) \qquad (1)$$

In modelling the observed latitude distribution it is crucial to include any dispersion in absolute magnitude. Because the volume surveyed increases very rapidly with absolute magnitude, the relatively rare bright stars dominate the distribution. This effect is particularly important when assessing the galactic distribution because an increase in the dispersion in absolute magnitude leads to a much narrower galactic distribution. Vogt (1973) has already discussed this effect for the

IRC sources. Because so little information is available on the absolute magnitudes of infrared stars, we have arbitrarily assumed a dispersion in absolute magnitude of one magnitude. Thus:

$$N(M) = \frac{N(z)}{\sqrt{2\pi}\sigma} \exp \frac{(M-M_o)^2}{2\sigma^2} \qquad (2)$$

This allows us to fit the observed galactic distribution with a single parameter R/β, which is the ratio of the limiting radius, R, of the sample for stars of the mean absolute magnitude to the exponential scale height, β, of the z distribution. We have found that the [4] distribution is best fit with R/β = 2 and the [10] distribution with R/β = 4. The predictions of the models for these parameters are drawn as solid lines on figure 6.

In order to obtain an absolute magnitude we must assume a value for β, the exponential scale height. The most reasonable guess is that these stars are closely related to normal giant stars for which a representative value of β is 300 pc. This implies $M_{[4]} = -9$ and $M_{[10]} = -12$.

Since we believe that we are observing the photospheres of more or less normal giant stars at 4 μm, we can convert the value of $M_{[4]}$ into a bolometric luminosity by assuming an effective photospheric temperature. The results of this computation are summarized in Table 7. From examination of this table it seems probable that the luminosity of these stars exceeds 10^4 $L_\odot$ which is an order of magnitude higher than that expected for solar type stars at the tip of the first red giant branch. We conclude that these objects are most likely on their second or later ascent of the red giant branch.

For the [10] sample we believe that the radiation is from a circumstellar dust shell. The characteristic temperature of these shells estimated from the observed [4] - [10] color of 2.5 magnitudes is 700 K. In Table 8 we have computed the bolometric luminosity of the dust shell radiation for a range of assumed circumstellar dust temperatures. We infer that the luminosity of the dust shells is only slightly less than the luminosity of the [4] sample. It is plausible to assume that the [10] sample stars have the same total luminosity as the [4] sample, but that the [10] objects have a sufficiently thick dust shell to absorb most of the luminosity of the underlying star.

Although it seems that we have produced a very fragile structure involving a large number of assumptions, the numerical details of our assumptions do not have a profound effect on our conclusions. The assumed dispersion in absolute magnitude has decreased the derived mean absolute magnitude by about 0.8 magnitudes from that which would result if no dispersion were assumed. Similarly, changing the assumed scale height by 50% would alter the absolute magnitude by only 0.9 magnitudes. We conclude that the derived luminosities are accurate within a factor of three. In particular we can rule out a reduction in luminosity by the factor of ten required to bring these objects down to the luminosity at the tip of the red giant branch.

We can also estimate the local space density for the [4] and [10] star samples. These derived values are particularily uncertain because they depend on the cube of the assumed scale height. We find:

$$N([4]) = 3 \times 10^{-7} \text{ pc}^{-3}$$

$$\text{and } N([10]) = 9 \times 10^{-8} \text{ pc}^{-3}.$$

Kirton and Fitzgerald (1974) found the density of late M stars (M5-9) to be 7×10^{-7} pc^{-3}. Considering the uncertainties in our determination, the [4] sample can be identified with the late type giants. The ratio between the number density of [10] sources and [4] sources is largely independent of our assumptions if both types of sources have the same scale height in the galactic plane. We find that for each giant with a substantial 10 μm excess there are three giants without such an excess. There are two straightforward interpretations of this ratio: 1) the development of a substantial dust shell takes about 75% of the time the star spends on the asymptotic giant branch, or 2) the presence of a dust shell indicates a basically different type of star. For the second hypothesis, the dust production might be controlled by the mass of the star and its chemical composition.

c. Predictions for the IRAS Survey.

One of the principal aims was to provide insight into the expected results of the IRAS all sky survey. A limiting flux at 10 μm of 1Jy, corresponding to [10] = +4, will reach objects with $M_{[10]} = -12$ to a distance of 16 kpc, well beyond the galactic center. If we assume that the galactic plane is uniform within such a radius, our derived number density implies 5×10^4 10 μm sources within that volume. This represents the minimum number of sources expected in the IRAS survey. A more realistic calculation might be to compute a local mass to 10 μm source count ratio and apply it to the entire mass of the galaxy. Using a projected local density of 25 $M_\odot/pc^2$ and the total mass of the Galaxy as 10^{11} $M_\odot$, we predict the total number of luminous 10 μm sources in the Galaxy as 2×10^5. The ratio of mass to the 10μm source count may vary considerably within the Galaxy. If the luminous 10 μm sources arise from stars with main sequence masses greater than 1 $M_\odot$ we would expect the ratio to be quite small in portions of the galaxy dominated by old stars. Thus this estimate is probably an upper limit to the total number of luminous 10 μm sources in the Galaxy. If we had extended the 10 μm counts from [10] = -1.5 to [10] = +4 we would have predicted 6×10^5 and 5×10^4 using slopes of +0.6 and 0.4. Since extrapolating the count magnitude relation with a slope of 0.4 corresponds to assuming a planar distribution, it is not surprising that this number agrees precisely with our previous estimate for a uniform galactic disk.

Our analysis for the absolute magnitude of the AFGL 10 μm sources has given us a more secure estimate of the volume of the Galaxy surveyed. Since the limiting magnitude does not correspond to dimensions larger than the Galaxy, the mixture of sources seen by IRAS is unlikely to differ substantially from that seen in the AFGL survey. Local sources whose numbers continue to increase directly with the volume surveyed are not sufficiently numerous to overtake the luminous 10 μm sources in a survey down to [10] = +4.

Thus the best current estimate for the expected IRAS sample is $\sim 10^5$ sources brighter than [10] = +4, with the majority of sources being luminous objects dominated at 10 μm by radiation from dust shells. These sources will be relatively faint at shorter wavelengths, so that observations that reach 4 to 6 magnitudes fainter at 4 μm will be required to reach all of the IRAS sample.

VI. Summary

The major conclusions of this study can be summarized as:

1. Using directly estimated noise limited magnitudes the published AFGL catalog can be pruned to reveal two virtually distinct lists of sources; those seen at 4 μm only (FMO) and those seen at 11, 20 or 27 μm (LL).

2. Statistical examination of the FMO source list reveals that the 4 μm survey presents a view of the sky virtually identical to that given by the 2.2 μm survey of Neugebauer and Leighton (1969). On the other hand, the sources seen at 10 μm represent a distinct stellar population with very red infrared colors.

3. Using the galactic distribution and an assumed galactic scale height the mean absolute magnitudes and local space density for the FMO and LL sources have been estimated as:

FMO $\quad M_{[4]} = -9$

$$N([4]) = 3 \times 10^{-7}\ pc^{-3}$$

and LL $\quad M_{[10]} = -12$

$$N([10]) = 9 \times 10^{-8}\ pc^{-3}$$

From reasonable estimates of the temperatures of these objects it seems unlikely that their bolometric luminosity is much less than $10^4\ L_{\odot}$ for both classes of stars.

4. These parameters are used to estimate that the IRAS survey is likely to see 10^5 sources brighter than [10] = +4 and that the majority of these sources will be similar to the AFGL sample.

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TABLE 1

WIRO CATALOG OF AFGL SOURCES

FOUR MICRON ONLY SUBCATALOG

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
56	40 8		37 54	DO 8341			M5	DO		0 20 18.55	38 28 37.3	SAO		FMO
60	70 8			SVS 49			M6	DO		0 22 13.00	69 52 42.0	SVS		FMO
66	-10 9		-7 57	UY CET	SRB	440.00	M7	H&B		0 24 33.57	- 6 52 52.4	SAO		FMO
68	40 10			AQ AND	SR	346.00	C5	GCVS		0 24 52.00	35 18 48.0	GCVS		FMO
71	20 7	103	17 55	TV PSC	SR	49.10	M3	HR	3	0 25 26.27	17 36 59.1	SAO		FMO
72										0 25 29.00	- 4 14 18.0	AFGL		FMO
73	50 7		47 113	DO 23365			M8	DO		0 26 14.26	48 8 15.2	SAO		W49
76				AD CEP	SR	166.00	M6	GCVS		0 27 37.00	82 19 18.0	GCVS		FMO
75	0 10	117	-4 54	12 CET			M0	HR	3	0 27 29.16	- 4 14 .2	SAO		FMO
82	30 12			TU AND	M	316.54	M7	DO		0 29 44.00	25 45 12.0	GCVS		FMO
88	50 10		48 183	SVS 5864			M5	DO		0 33 59.93	48 40 36.7	SAO		FMO
39	40 11	152	43 113	GC 726			K5	IRC	3	0 34 2.86	44 12 47.3	SAO		FMO
4005	50 12		44 128	BZ AND	LB		M5	DO		0 34 53.18	45 19 45.1	SAO		FMO
94	30 14	165	30 91	DEL AND			K3	IRC	3	0 36 38.86	30 35 15.8	SAO		FMO
100	60 17	168	55 139	ALF CAS	CST		K0	IRC	2	0 37 39.31	56 15 48.6	SAO		FMO
210	-10 21	402	-8 244	THE CET			K0	IRC	3	1 21 31.36	- 8 26 27.2	SAO		W49
211	60 48			BT CAS	M	399.00	M8	GCVS		1 21 44.00	60 49 18.0	GCVS		FMO
211														
224	10 17	434	5 194	MUU PSC			K4	IRC	3	1 27 33.72	5 53 12.2	SAO		FMO
226	0 19		2 222	R PSC	M	344.04	M6	DO		1 28 3.36	2 37 28.0	SAO		FMO
227	60 53		61 284	IN CAS	SRB	323.00	M5	DO		1 28 37.78	62 4 19.6	SAO		FMO
228	20 26	437	14 231	ETA PSC			G8	IRC	3	1 28 48.20	15 5 19.4	SAO		FMO
231	70 29		65 179	SVS 5931			M7	DO		1 31 16.46	65 32 31.4	SAO		FMO
237	50 41	464	47 467	51 AND			K3	IRC	3	1 34 54.64	48 22 32.7	SAO		FMO
243	10 20	489	4 293	NUU PSC			K3	HR	3	1 38 49.56	5 14 7.1	SAO		FMO
327	60 90		56 609	DO 25684			M2	DO		2 21 47.04	57 12 42.6	SAO		W49
4022	50 60	699	49 656	65 AND			K4	IRC	3	2 22 16.47	50 3 13.0	SAO		FMO
332	60 91		60 478				M4	LWD	2	2 23 45.00	60 27 54.0	IRC		FMO
332														
335	50 62			RR PER	M	390.14	M8	DO		2 25 5.00	51 3 6.0	GCVS		FMO
340	80 6		76 81	GC 3033			M0	IRC		2 29 3.54	76 29 57.5	SAO		FMO
342										2 29 22.00	14 14 36.0	AFGL		FMO
350	50 69			EE PER	LB		M6	DO		2 32 38.00	53 16 18.0	GCVS		FMO
351	30 43	750	34 469	15 TRI			M3	IRC	7	2 32 44.24	34 28 14.4	SAO		FMO
354	-10 37	759	-8 489	80 CET			M0	IRC	3	2 33 32.23	- 8 2 53.2	SAO		FMO
355	30 44	758	33 470	R TRI	M	266.48	M4E	HR	7	2 34 .05	34 2 51.4	AGK3		W49
359	60 94		58 501	GP CAS	LB		M3	GCVS		2 36 4.66	59 22 58.6	AGK3	C	FMO
365	40 47		39 596	DO 9448			M7	DO		2 36 52.79	39 37 13.3	SAO		FMO
367	30 46		30 428	Y ARI	SRB	109.00	M7	DO		2 38 .68	30 59 10.5	SAO		FMO
487	50 95	1017	49 917	ALF PER			F5	IRC	2	3 20 44.44	49 41 6.0	SAO		FMO
491	70 43	1032	71 201	DO 27100			M1	HR		3 25 5.92	71 41 32.5	SAO		FMO
492	50 98	1052	47 843	SIG PER			K3	IRC	3	3 27 2.28	47 49 27.8	SAO		FMO
494	0 46			DO 587			M6	H&B		3 28 8.00	- 2 6 30.0	IRC		W49
496										3 29 2.00	19 54 46.0	AFGL		FMO
497	-10 48	1084	-9 697	EPS ERI			K2	IRC	5	3 30 34.36	- 9 37 34.8	SAO		FMO
506	60 125	1105	62 597	SVS 328			S5	IRC		3 37 47.68	63 3 24.9	SAO		FMO
507	50 100		51 762	SVS 100294			M	DO		3 37 47.30	51 20 36.2	AGK3		FMO
511	-10 49			VY ERI	SRB	102.50	M6	H&B		3 38 53.00	-10 54 36.0	GCVS		FMO
4047	70 53		69 258	DO 28302			M1	DO		4 24 35.37	69 16 9.3	SAO		FMO
561	10 60		9 585	R TAU	M	323.72	M6E	IRC		4 25 33.46	10 3 8.9	SAO		FMO

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
56	6.95	IRC	4.62	1.78	1.3														
60	12.20	DO	8.41	2.31	1.2	-.8													
66	9.10	IRC	4.75	.25	-.3	-1.4													
68	8.10	DO	5.81	1.64	1.0	-1.3			17/12/78	1.53	1.09	1.24	.78	.55	.28	.32	-.22		JAH
71	6.90	IRC	2.69	-.16	-.4	-1.2	-2.5												
72					.8														
73	7.52	IRC	4.35	1.19	1.0				18/ 4/80	1.26	.99	1.46	1.27	.99	1.01	.80	.69		RDG
76					1.2														
75	5.72	IRC	.31	1.92	1.2														
82			6.05	2.05	.9														
88	8.40	IRC	4.89	1.26	1.0														
89	5.29	IRC	3.64	1.20	1.2														
4005	8.40	IRC	5.46	2.00	1.3														
94	3.21	IRC	*	.44	.2														
100	2.24	IRC	*	-.46	-.5	-.5													
210	3.61	IRC	2.74	1.20	.9				21/ 5/80	1.16	1.10	1.24	1.10	1.16	1.03	1.02			RDG
211			6.73	2.28	1.2	-.7			16/ 8/78	2.53	1.69	1.35	.71	.22	-.09	-.21			RDG
211									1/11/78	2.25	1.44	.92	.31	-.09	-.22	-.35	-1.20	-1.14	RDG
224	4.86	IRC	3.68	1.52	1.1														
226	7.00	IRC	5.35	1.92	1.2	-.7			19/11/78	2.30	1.66	1.36	.78	.55	.22	.30	-.06	.30	RDG
227	7.80	IRC	5.66	2.11	1.3				17/ 8/78	2.13	1.61	.86	1.48	1.44	1.26				RDG
228	3.62	IRC	2.91	1.45	1.1		-3.1	-6.2											
231	8.90	IRC	4.97	1.28	1.1														
237	3.56	IRC	2.56	.79	.5														
243	4.43	IRC	3.27	1.26	.9														
327	8.40	IRC	5.58	1.95	1.2		-3.0		1/11/78	1.78	1.45	1.51	1.06	.77	.54	.45	-.46		RDG
4022	4.70	IRC	3.37	1.13	.8														
332	9.50	BD	7.24	1.89	1.1	-1.4			27/ 7/78	1.84	1.20	1.01	-.03	-.78	-1.22	-1.24			GG
332									1/11/78	1.60	1.00	.74	-.26	-.85	-1.42	-1.27	-2.09	-2.32	RDG
335			6.45	1.55	.4	-.6			20/ 8/78	1.46	.78	.47	-.01	-.40	-.78	-.82	-1.35	-1.64	JAH
340	6.86	IRC	4.76	1.50	1.1														
342					1.3														
350	11.30	DO	6.88	1.99	1.2				20/ 8/78	1.88	1.55	2.67	1.26	.96	.59	.51	-.25		JAH
351	5.45	IRC	3.45	.78	.3	-.7													
354	5.52	IRC	3.77	1.28	1.2														
355	5.30	IRC	5.47	1.07	-.1	-.6			30/12/77	1.13	.65	.39	-.06	-.21	-.45	-.43	-.91	-.95	JAH
359	11.90	AGK3	6.22	1.97	1.3														
365	8.10	IRC	5.21	1.84	.9														
367	8.90	IRC	5.25	1.39	.9														
487	1.79	IRC	*	.54	.1														
491	6.66	IRC	4.30	1.38	1.0														
492	4.37	IRC	3.20	1.13	.8	-.9	-3.1												
494	9.70	DO	5.81	1.76	.9				20/10/80	1.67	1.41	1.68	1.40	1.21	1.07	1.03	.66		GG
436					1.0														
497	3.73	IRC	2.97	1.62	1.3	-1.2													
506	5.10	IRC	2.79	.23	0.0	-1.3													
507	8.40	DO	5.56	1.01	.3														
511			5.65	2.13	1.1		-3.0												
4047	7.02	IRC/	5.06	2.54	1.3	-.6			17/12/78	2.46	2.33	2.46	2.62	2.84	2.24	2.46	1.35		JAH
581	7.40	IRC	5.07	1.15	.4	-.8			8/ 3/78	.96	.29	-.02	-.47	-.83	-1.03	-1.32	-1.43	-.88	JAH

GL	IRC		HR	BD		OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
582	40	89				GI PER	LB		M	DO		4 26 19.00	39 45 42.0	GCVS		FMO
583	60	143		57	806	RV CAM	SRB	101.00	M7	DO		4 26 31.90	57 18 12.7	SAO		W49
586	30	87				DO 10530			M5	DO		4 28 1.00	27 23 6.0	IRC		FMO
590	30	88							M7	VOGT		4 29 14.00	31 0 30.0	IRC		FMO
592												4 29 29.00	8 51 0.0	AFGL		FMO
593	50	121		48	1106	DO 28391			M4	DO		4 29 48.35	48 36 29.4	SAO		FMO
600	30	90				IU TAU	SRA	418.00	M1	DO		4 32 50.00	28 24 54.0	GCVS		FMO
602	40	93	1454	40	1000	58 PER	SPBI		KO	IRC		4 33 13.13	41 9 50.6	SAO		FMO
605	-30	38		-27	1800	UU ERI	SRB	340.00	M7	IRC		4 34 32.84	-27 40 43.6	SAO		W49
606	70	54				T CAM	M	373.78	M5	DO		4 35 15.00	66 3 12.0	GCVS		FMO
608	10	66				RX TAU	M	335.06	M7E	GCVS		4 35 32.00	8 14 13.0	GCVS		FMO
610	-10	73	1481	-14	933	53 ERI			K2	IRC	3	4 35 53.32	-14 24 1.6	SAO		FMO
612												4 37 27.00	17 25 30.0	AFGL		FMO
614	-20	59	1496	-19	988	DM ERI	SRB	30.00	M4	IRC	7	4 38 15.15	-19 45 58.4	SAO	C	FMO
615	-10	75				BX ERI	SR	165.00	M7	H&B		4 38 15.00	-14 17 54.0	GCVS		FMO
619	10	68				BZ TAU	SR	400.00				4 39 43.00	6 46 18.0	GCVS		FMO
740	-10	91		-6	1167	EX ORI	LB		M7	GCVS	7	5 22 2.19	- 6 11 28.9	SAO		W49
4053												5 22 45.80	38 19 56.0	G&H		FMO
749	30	115		29	897	DO 11262			M1	DO		5 23 58.52	29 52 45.9	SAO		FMO
751	20	106		22	909				M7	VOGT		5 24 16.96	23 3 55.2	AGK3		FMO
752	20	107	1816	17	931	117 TAU			M1	HR	7	5 25 7.35	17 11 57.2	SAO		FMO
753	60	157	1802	62	759	17 CAM			M1	HR	7	5 25 26.42	63 1 42.1	SAO		FMO
754	30	117		32	996	DO 11278			M4	DO		5 25 37.09	32 26 17.2	SAO		FMO
755	40	130		38	1168	AD AUR	SRB	162.30	M2	DO		5 25 35.00	39 0 42.0	GCVS		FMO
756	-20	71	1829	-20	1096	BET LEP			G5	HR	3	5 26 6.09	-20 47 52.9	SAO		W49
759	0	75	1834	-1	913	31 ORI	CST		K4	IRC	3	5 27 11.52	- 1 7 48.1	SAO		FMO
769	10	88		12	815	DO 1158			M4	DO		5 30 5.42	13 1 3.4	SAO		FMO
771	-20	73	1865	-17	1166	ALF LEP			F0	IRC	2	5 30 31.39	-17 51 24.2	SAO		FMO
777	50	148	1866	54	914	DO 19463			M0	HR	7	5 32 28.74	54 23 53.4	SAO		FMO
780	10	90		8	1005	SVS 6229			M5	DO		5 32 32.78	8 40 9.0	SAO		FMO
782	40	134				IX AUR	LB		M7	DO		5 32 46.00	37 59 18.0	GCVS		FMO
787												5 35 26.00	42 35 42.0	AFGL		FMO
789												5 35 54.00	18 25 48.0	AFGL		FMO
793	-10	94				RW LEP	SR	149.90	M8	H&B		5 36 38.00	-14 3 48.0	GCVS		W49
796	-10	95							C	H&B		5 37 19.00	- 8 11 24.0	IRC		FMO
797	30	124	1939	31	1049	MO AUR			M1	DO		5 37 26.94	31 53 43.3	SAO		FMO
799									C1	CK2		5 37 46.60	13 46 45.0	G&H		FMO
800	30	125				AB TAU	SRA	141.97	M6	DO		5 37 54.00	28 5 0.0	GCVS	C	FMO
801	10	94				DO 1241			M	DO		5 38 21.00	12 16 0.0	IRC		FMO
802	40	136				SZ AUR	M	453.38	M6	DO		5 38 30.00	38 54 42.0	GCVS		FMO
803	20	118		17	979	DO 11484			M3	DO		5 38 27.88	17 29 52.3	SAO		FMO
804	0	82				Y ORI	M	271.30	M5	H&B		5 39 6.00	- 4 9 30.0	GCVS		W49
925	0	104		-2	1581	V MON	M	333.80	M5E	DO		6 20 12.43	- 2 10 10.0	SAO		FMO
927	50	164	2289	49	1488	PSI1 AUR	LC?		M0	HR	2	6 21 2.88	49 18 56.9	SAO		FMO
931	60	167	2293	58	927	5 LYN			K4	HR	3	6 22 27.09	58 26 49.9	SAO		FMO
933	-10	122		-9	1452				F0	IRC		6 22 37.96	- 9 7 23.2	SAO	C	FMO
934	10	121	2308	14	1283	BL ORI	LB		C6	HR		6 22 36.93	14 45 4.2	SAO		FMO
935									C	CK2		6 23 4.70	- 9 30 21.0	JYCE		FMO
936												6 23 15.00	5 35 6.0	AFGL		FMO
945	60	168				V LYN	SRB		M7	DO		6 25 7.00	61 34 48.0	GCVS	C	W49

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
582	8.10	DO	6.78	1.63	1.0	-.1			20/ 8/78	1.46	.82	.89	.14	.03	-.70	-.37	-.20		JAH
583	8.20	IRC	4.45	.65	.3	-1.0	-3.2		30/12/77	.58	.35	.44	-.06	-.36	-.74	-.38	-1.43	-1.40	JAH
586	11.50	DO	6.72	1.45	.7														
590			5.68	1.38	.8				1/11/78	1.35	.78	.63	.30	-.01	-.31	-.31	-1.40		RDG
592					1.0														
593	8.30	IRC	.30	1.17	.6														
600	11.50	DO	7.25	1.37	.5	-.4			17/ 2/78	1.54	.92	.78	.29	.03	-.28	-.55	-.90	-.81	RDG
602	4.27	IRC	3.24	1.32	1.1														
605	9.00	IRC	5.28	1.31	1.2														
606			4.20	.48	-.1	-.5			21/11/78	.61	.24	.41	.01	-.02	-.21	-.17	-.42	-.03	RDG
608			7.10	1.45	.6	-1.4			8/ 3/78	1.43	.72	.27	-.08	-.47	-.69	-.99	-1.02		JAH
610	3.86	IRC	3.07	1.33	.8														
612					.8														
614	4.30	IRC	*	-.35	-.5	-.7													
615			4.91	.50	0.0	-1.0													
619			6.26	1.99	1.2	-1.2			21/11/78	2.39	1.65	1.21	.65	.28	-.13	-.17	-.91		RDG
740	9.10	IRC	5.39	1.18	.6				18/ 4/80	1.30	.89	.97	.49	.11	-.23	-.34	-.80		RDG
4053					.8				7/10/76	2.92	1.38	.87	-.23		-.55		-.80		G&H
749	8.00	IRC	5.07	1.74	1.1														
751	11.20	ACK3	5.84	1.75	.9				2/11/78	1.81	1.47	1.72	1.13	.74	.31	.66	-1.01		RDG
752	6.86	IRC	4.32	1.81	1.1		-3.6												
753	5.53	IRC	3.58	.95	.8														
754	8.80	IRC	4.59	.75	.7	-1.2													
755			5.88	1.78	.9														
756	2.84	IRC	*	.96	.8	-.9			18/ 4/80	.80	.76	.99	.86	.71	.83	.85	.76		RDG
759	4.70	IRC	3.17	.90	.5														
769	0.80	IRC	5.14	1.42	.7														
771	2.59	IRC	2.35	1.87	1.3	-1.1													
777	5.79	IRC	4.21	1.68	1.3														
780	8.20	IRC	4.16	.80	.3		-3.8												
782	10.90	DO	6.15	2.11	1.0														
787					.6														
789					1.0														
793			5.48	.68	.1	-.5			17/12/78	1.01	.58	.40	-.05	-.27	-.45	-.82	-1.42	-1.61	JAH
796			8.42	2.70	.7	-1.1			2/11/78	2.45	1.65	1.62	.45	.52	.29	.52			RDG
797	6.05	IRC	3.99	.86	.5														
799	15.50	CK2			1.0	-1.2			25/10/75	3.53	2.02	1.20	.08	-.08	-.45	-.44	-.95		G&H
800	9.70	DO	16	.88	.2														
801	11.20	DO	.69	2.11	.5	-1.0													
802			4.98	1.13	.4				21/12/77	1.24	.61	.31	-.19	-.39	-.81	-1.11	-1.23		G&H
803	7.50	IRC	4.81	1.78	1.1														
804			7.28	2.48	1.1				17/ 4/80	2.23	1.69	1.47	.93	.68	.35	.40	.56		RDG
925	6.00	IRC	4.84	1.23	.1				8/ 3/78	1.29	.69	.53	-.21	-.40	-.48	-.63	-.79		JAH
927	5.02	IRC	3.14	.59	.2	-1.2													
931	5.22	IRC	3.92	1.61	1.1														
933	9.30	IRC	7.28	2.64	.3	-1.2			2/11/78	2.55	.93	.15	-.92	-1.02	-1.36	-1.15	-1.86		RDG
934	6.32	IRC	4.29	.75	.1	-.7			21/12/77	.93	.68	.79	.29	.32	.09	.11	-.20		G&H
935					1.0	-1.3			2/11/78	5.34	2.73	1.40	-.16	-.37	-.78	-.71	-1.54		RDG
936					1.1														
945	11.50	DO	5.19	1.39	.8				30/12/77	1.22	.93	1.01	.44	0.00	-.40	-.33	-1.20	-1.22	JAH

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC. 1950.00	SOURCE	COMMENT	CLASS
947	20 147			AQ GEM	LB		M6	DO		6 26 8.00	16 37 42.0	GCVS		FMO
954										6 29 5.50	43 19 24.0	G&H		FMO
958	60 171			RT CAM	M	365.84	M8	DO		6 30 32.00	64 8 12.0	GCVS		FMO
959	20 152		16 1194	CR GEM	LB		M	DO		6 31 30.82	16 7 13.7	AGK3		FMO
962	50 170		45 1324	TU AUR	SRB	73.00	M7	DO		6 31 55.72	45 39 51.0	SAO		FMO
964	10 126		5 1306	DO 1635			M5	DO		6 31 56.05	5 0 31.3	SAO		FMO
967	10 128		14 1350	DY GEM	SRA		M4	DO		6 33 7.00	14 14 6.0	GCVS		FMO
970	20 153			AX GEM	LB		M6	DO		6 34 9.00	21 10 6.0	GCVS		W49
977	0 119			SY MON	M	422.17	M9	H&B		6 35 0.00	- 1 20 54.0	GCVS		FMO
980	-20 98	2443	-18 1492	NU3 CMA			K1	IRC	2	6 35 41.39	-18 11 34.1	SAO		FMO
982	60 172			U LYN	M	435.94	M6	DO		6 36 21.00	59 55 12.0	GCVS		FMO
985	-10 135	2450	-14 1525	GC 8694			K3	IRC	3	6 36 59.52	-14 5 58.5	SAO		FMO
988										6 38 34.00	27 6 42.0	AFGL		FMO
991	60 173		55 1109	SU LYN	SRB	126.00	M6	DO		6 38 45.74	55 31 24.9	SAO		FMO
994	40 161	2459	44 1518	PSI4 AUR			K5	IRC	3	6 39 26.75	44 34 29.1	SAO		FMO
995										6 39 23.00	8 50 6.0	AFGL		FMO
1108	-20 129		-20 1889				M2	IRC		7 20 12.70	-20 24 35.7	SAO		W49
1110	.	2742	82 201	VZ CAM	SR	23.70	M4	GCVS		7 20 40.98	82 30 50.4	SAO		FMO
1109	50 178		47 1440	SVS 6578	IB		M7	DO		7 20 49.96	47 16 42.0	AGK3		FMO
1112	-30 90	2822	-27 4020	GC 9870			K2	IRC		7 21 28.18	-27 44 9.9	SAO		FMO
1113										7 22 26.00	-21 25 12.0	AFGL		FMO
1114	30 183	2821	28 1385	IOT GEM			K0	IRC	3	7 22 37.38	27 53 57.2	SAO		FMO
1117	30 184			XX GEM	M	383.90	M9	VOGT		7 23 0.00	33 28 12.0	IRC	C	FMO
1118	-10 163			TT MON	M	322.97	M8	H&B		7 23 15.00	- 5 44 54.0	GCVS		FMO
1122	40 177			VX AUR	M	322.20	M8	DO		7 25 5.00	41 4 36.0	GCVS		W49
1123	50 181		48 1537	SVS 100869			M7	DO		7 25 1.10	48 1 28.7	SAO		FMO
1124										7 25 4.00	-26 18 48.0	AFGL		FMO
1127	10 164	2854	9 1660	GAM CMI			K3	IRC	3	7 25 26.45	9 1 42.2	SAO		FMO
1129										7 26 37.00	-10 15 6.0	AFGL		FMO
1131	-20 131						C	H&B		7 27 1.00	-19 21 24.0	IRC		FMO
1133	50 182		50 1439	SVS 100875			M7	DO		7 27 15.89	50 9 16.8	SAO		FMO
1134										7 27 58.00	51 53 6.0	AFGL		FMO
1136	20 181			DO 13079			M6	DO		7 28 13.00	20 39 0.0	IRC		W49
1144	30 166	2891	32 1581	ALF GEM			A1	HR	5	7 31 24.65	31 59 59.1	SAO		FMO
1145	-10 169	2902	-14 1971	KQ PUP	SPBI		M2P	HR	2	7 31 30.07	-14 24 52.0	SAO	C	FMO
1148										7 31 59.00	37 9 48.0	AFGL		FMO
4073	50 184	2903	46 1286	DO 31700			M0	HR	7	7 32 54.14	46 17 33.1	SAO		FMO
1150	30 190	2905	27 1424	UPS GEM			M0	IRC	3	7 32 50.60	27 0 31.0	SAO		FMO
1160	40 183	2935	38 1803	DO 13215			M0	HR	7	7 36 52.94	38 27 38.7	SAO		FMO
1161	10 170	2943	5 1739	ALF CMI			F5	IRC	4	7 36 41.12	5 21 16.8	SAO		FMO
4076										7 37 34.00	- 8 45 36.0	AFGL		FMO
1162										7 37 38.00	-21 35 54.0	AFGL		W49
1163	20 187			Y GEM	SRB	160.00	M7	DO		7 38 14.00	20 32 42.0	GCVS		FMO
1167	10 172	2965	13 1737	DO 2303			M1	HR		7 39 3.64	13 35 56.2	SAO		FMO
1168	10 173	2967	14 1729	SVS 1107			M3S	HR		7 39 14.11	14 19 37.3	SAO		FMO
1169	0 161						M8	VOGT		7 39 21.00	- 4 3 30.0	IRC		FMO
4083	10 188	3290	11 1830	21 CMC			M2	HR	7	8 21 11.21	10 47 40.3	SAO		FMO
1249	50 191			DO 32264			M5	DO		8 21 54.00	52 26 30.0	IRC		FMO
1253	0 175		-4 2334				K5	IRC		8 23 30.48	- 4 43 41.9	SAO		FMO
1253														

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
947	11.40	DO	5.63	1.06	.5														
954	12.00	JYCE			1.2	-1.4			25/10/75	3.52	1.80	.80	-.62		-1.37		-1.21		G&H
958	12.00	DO	6.54	2.13	.9														
959	9.10	DO	6.04	1.45	.8				28/12/78	1.44									RDG
962	6.50	IRC	4.91	1.17	.6														
964	7.20	IRC	4.46	1.45	1.1														
967	9.50	DO	5.84	1.64	1.3	-.5			17/12/78	1.97	1.69	1.72	1.50	1.08	.71	.22	.08		JAH
970	9.50	DO	5.40	1.69	1.2	-.3			17/12/78	1.77	1.53	1.46	.97	.59	.57	.95	-.22		JAH
977	12.60	DO	6.59	1.51	.2	-1.3													
980	4.43	IRC	3.53	1.89	1.2														
982	9.50	DO	5.95	1.12	.4	-1.3	-3.0		17/ 2/78	1.70	.93	.55	-.31	-.84	-1.33	-1.33	-1.62	-1.71	RDG
985	4.83	IRC	3.71	1.55	1.0				17/12/78	4.77	2.52	.89							JAH
986					1.2														
991	8.30	IRC	5.16	1.56	.9	-1.0			17/ 2/78	1.57	1.24	1.34	.79	.80	.60	.63	.71		RDG
994	5.02	IRC	3.81	1.55	.9														
995					1.1														
1108	7.30	IRC	4.18	1.03	.4				2/11/78	.93	.62	.70	.55	.55	.47	.58			RDG
1110	5.10:	SAO			-.2	-1.3													
1109	10.20	DO	6.18	2.07	1.4														
1112	5.13	IRC	4.01	1.70	1.2														
1113					1.3														
1114	3.80	IRC	3.03	1.46	1.3	-.8													
1117			7.55	2.19	1.3		-2.7		17/ 2/78	1.80	1.49	1.23	.68	.33	.03	-.07	-.52	-.66	RDG
1116			5.35	2.31	1.1		-3.0		17/12/78	1.75	1.28	.89	.35	-.19	-.24	-.22	-.91	-2.02	JAH
1122			6.26	1.71	1.1				18/ 4/80	1.62	1.18	1.14	.73	.50	.29	.19	-.06	-.14	RDG
1123	6.90	IRC	4.32	1.36	1.0														
1124					1.3														
1127	4.29	IRC	3.07	.86	.5														
1129					1.3														
1131	12.10	LWD	8.78	2.70	.7	-1.2			2/11/78	2.28	.77	0.00	-.82	-1.00	-1.36	-1.25	-2.30		RDG
1133	8.10	IRC	5.22	2.08	1.3		-3.9												
1134					1.2														
1136	10.50	DO	6.31	1.77	.9	-.1			18/ 4/80	1.88	1.68	1.81	1.43	1.05	.67	.77	.29		RDG
1144	1.99	IRC	*	1.46	1.1														
1145	4.98	IRC	2.89	.02	-.3		-3.0		19/10/80	.04	-.19	.12	-.16	-.21	-.32	-.27	-.37		GG
1146					1.3														
4073	5.65	IRC	4.24	1.87	1.3														
1155	4.07	IRC	2.58	.27	.1	-1.2													
1160	5.67	IRC	4.33	1.81	1.2		-3.1		17/12/78	1.70	1.60	1.94	1.56	1.56	1.53	1.48	1.18		JAH
1161	.34	IRC	*	-.65	-.8														
4076					-3.4														
1162					1.3	-.4													
1163	9.50	DO	5.12	1.22	.9				17/ 2/78	1.16	.88	.87	.51	.44	.27	.31	-.04		RDG
1167	5.93	IRC	4.04	1.39	1.0														
1168	5.56	IRC	3.46	.68	.8														
1169			5.76	1.82	1.3				2/11/78	1.67	1.28	1.28	.86	.52	.18	.32			RDG
4083	6.16	IRC	4.68	2.13	1.3														
1249	9.70	DC	5.45	1.61	1.2				17/12/78	1.61	1.39	1.68	1.34	1.73	1.04	1.09	1.09		JAH
1253	8.80	IRC	4.91	.83	.2	-1.0			11/ 4/78	.96	.65	.83	.27	0.00	-.28	-.53	-.89		JAH
1253									2/11/78	.80	.31	.41	-.04	-.21	-.56	-.52	-1.95		RDG

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
1254										8 23 43.00	3 53 0.0	AFGL	C	W49
1255	10 189	3319	13 1912	BP CNC	M	203.50	M3	HR	7	8 23 58.08	12 49 15.7	SAO		FMO
4085	60 187	3323	61 1054	OMI UMA			G5	IRC	3	8 26 7.63	60 53 14.6	SAO		FMO
1262	20 200	3357	18 1963	THE CNC			M1	HR	3	8 28 44.80	18 15 53.3	SAO		FMO
1265	70 85		67 550	DO 32354			M8	DO		8 29 48.27	67 21 37.5	SAO		FMO
1271	-20 171			W PYX	SRA	166.00	M7	H&B		8 34 40.00	-17 48 36.0	GCVS		FMO
1274										8 35 44.60	-10 13 41.0	LKVR		FMO
1274														
1274														
1276	0 176	3418	3 2026	SIG HYA			K2	IRC	3	8 36 8.67	3 31 5.5	SAO		FMO
1278										8 36 23.00	- 3 59 12.0	AFGL	C	W49
1280	-10 199		-9 2612	RV HYA	SRC	116.00	M5	GCVS	2	8 37 18.54	- 9 24 32.9	SAO		FMO
1348	10 205		8 2215	DO 2756			M5	DO		9 20 49.96	7 55 45.7	SAO		FMO
1351	30 211	3731	26 1939	SVS 6712			K2	IRC	3	9 21 44.78	26 23 55.3	SAO		FMO
1353	-10 217	3748	-8 2680	ALF HYA			K4	IRC	3	9 25 7.79	- 8 26 27.5	SAO		FMO
1354	40 205		36 1963	RS LMI	LB		M7	DO		9 25 29.78	36 22 44.9	SAO		FMO
1357	40 207	3769	35 2015	8 LMI			M1	IRC	7	9 28 30.18	35 19 31.3	SAO		FMO
1358	20 211	3773	23 2107	LAM LEO			K5	IRC	3	9 28 52.25	23 11 22.2	SAO		FMO
1363		3751	81 302	DO 32868			K3	HR	3	9 30 7.39	81 33 .3	SAO		FMO
1366	30 213	3620	31 2011	GC 13265			M2	IRC	7	9 33 45.14	31 23 13.1	SAO		W49
1369	0 190	3845	-0 2231	IOT HYA			K3	IRC	3	9 37 18.15	- 0 54 53.8	SAO		FMO
1371	30 214	3850	31 2026	GC 13369			K6	IRC	7	9 38 37.98	31 30 22.2	SAO		FMO
1416	-20 210	4094	-16 3052	MUU HYA			K4	IRC	3	10 23 40.21	-16 34 49.6	SAO		FMO
1419	10 231	4127	14 2255	46 LEO			M2	HR	7	10 29 31.73	14 23 40.1	SAO		FMO
1423	70 95		70 618	SVS 6789	L		M6	DO		10 30 41.00	70 1 24.0	SVS	C	FMO
1423														
1428	-10 243			FF HYA	SR	20.00	M6	H&B		10 35 26.00	-11 45 54.0	GCVS		FMO
1431	70 98	4181	69 586	GC 14713			K3	IRC	3	10 39 31.06	69 20 18.4	SAO		FMO
1431														
1483	-10 254	4402	-10 3260	EPS CRT			K5	IRC	3	11 22 4.91	-10 35 5.4	SAO		W49
1483														
1486										11 23 2.00	-12 14 6.0	AFGL		FMO
1488	20 229			AF LEO	SRB	107.00	M5	GCVS		11 25 19.00	15 25 48.0	GCVS		FMO
1489	50 211		45 1924	ST UMA	SRB	81.00	M7	DO		11 25 6.89	45 27 37.7	SAO		FMO
1492	0 206	4432	-2 3360	HFE 56			K4	IRC	3	11 27 45.52	- 2 43 38.7	SAO		FMO
1494	70 107	4434	70 665	LAM DRA			M0	HR	3	11 28 27.55	69 36 26.1	SAO		FMO
1495	-10 256		-11 3114	RR CRT	SRB		M5	IRC		11 29 9.36	-12 6 19.9	SAO		FMO
1497	-30 177	4449	-30 9303	GC 15844			M0	HR	3	11 30 25.42	-30 48 39.6	SAO		FMO
1502	10 243	4483	8 2532	OME VIR			M6	HR	3	11 35 52.90	8 24 40.4	SAO		W49
1502														
1503	-20 230	4491	-15 3323	GC 16006			M2	IRC	7	11 37 18.50	-16 20 34.7	SAO		FMO
1547	-10 268		-11 3291	GC 16886			M0	IRC		12 20 43.89	-11 32 5.8	SAO		FMO
1549	0 217			SS VIR	M	354.66	N	DO		12 22 43.00	1 2 30.0	GCVS		FMO
1550	60 217	4726	57 1373	71 UMA			M3	HR	7	12 22 40.21	57 3 16.9	SAO		FMO
1551	30 238	4737	29 2288	GAM COM			K1	IRC	3	12 24 26.87	28 32 46.1	SAO		FMO
1552	60 218	4745	56 1596	73 UMA			M2	HR	7	12 25 12.80	55 59 21.7	SAO		FMO
1555	70 113	4765	70 700	CQ DRA			M4	DO	7	12 27 55.84	69 28 40.8	SAO		FMO
1558	-20 240	4786	-22 3401	BET CRV			G5	IRC	3	12 31 45.34	-23 7 13.6	SAO		W49
1558														
1564	30 241			DO 14615			M5	DO		12 34 26.00	27 19 54.0	IRC		FMO

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
1254					1.2														
1255	5.50	IRC	3.43	.66	.6														
4085	3.36	IRC	2.81	1.43	1.0														
1262	5.32	IRC	3.84	1.42	1.2														
1265	9.00	IRC	5.20	1.74	1.3				17/12/78	1.69	1.48								JAH
1271			5.33	1.65	.9														
1274					1.2	-1.4			27/ 3/78	3.31	2.35	1.91	.71	-.01	-.50	-.41	-1.07	-1.50	JAH
1274									12/ 6/78	3.60	1.96	.94	-.43	-.92	-1.48	-1.39	-3.09	-3.39	RDG
1274									17/ 4/80	4.03	2.43	1.57	.05	-.24	-1.25	-.28	-.43		RDG
1276	4.44	IRC	3.56	1.80	1.2														
1278					1.3														
1280	7.70	IRC	4.01	.54	.2				21/12/77	.49	.28	.35	-.13	-.58	-1.04	-1.00	-1.20		G&H
1348	7.25	IRC	4.70	1.65	1.1														
1351	4.46	IRC	3.50	1.61	1.2														
1353	1.99	IRC	*	-1.36	-1.5	-1.2			8/ 3/78	-1.08	-1.21	-1.00	-1.23	-1.32	-1.18	-1.45	-1.19		JAH
1354	6.00	IRC	5.18	1.49	.9				21/12/77	1.44	1.18	1.24	.74	.83	.34	.34			G&H
1357	5.37	IRC	4.02	1.53	1.0														
1358	4.31	IRC	2.87	.66	.2	-.5													
1363	4.44	HR			.7	-.8													
1366	5.56	IRC	4.02	1.50	1.2	-.6			18/ 4/80	1.52	1.36	1.53	1.33	1.30	1.27	1.38	1.49		RDG
1369	3.89	IRC	2.83	.91	.7	-.9			8/ 3/78	1.06	.96	1.03	.96	.93	.85				JAH
1371	5.91	IRC	4.44	1.88	1.3														
1416	3.82	IRC	2.45	.40	.1	-.3													
1419	5.54	IRC	3.71	1.04	.6														
1423	10.00	DO	5.73	1.48	.9	-1.1	-3.3		7/ 3/78	1.44	1.09	1.06	.70	.37	.12	-.03	-.57		JAH
1423									5/ 4/78	1.53	1.16	1.12	.56	.42	.03	-.02	-.25		RDG
1428			4.43	.69	0.0	-1.0			21/12/77	1.07	.80	.80	.24	.07	-.52	-.62	-.77		G&H
1431	5.00	IRC	3.87	1.71	1.3	-1.2			27/ 3/78	1.68	1.53	1.69	1.50	1.61	1.34	1.45			JAH
1431									5/ 4/78	1.74	1.59	1.77	1.68	1.65	1.52	1.50	1.41		RDG
1453	4.80	IRC	3.28	.98	.6				19/ 5/79	1.11	.90	1.19	1.10	.91	.88	1.00	.73		JAH
1463									18/ 4/80	.92	.77	1.02	.84	.79	.70	.79	.61		RDG
1486					-.8														
1488	9.30	DO	5.33	1.36	.9	-.5			28/12/77	1.38	1.11	1.17	.62	.13	-.33	-.27	-.93	-1.07	G&H
1489	6.50	IRC	3.88	.58	.1				20/12/77	.55	.20	.19	-.04	-.26	-.47	-.74	-.95	-.92	G&H
1492	4.77	IRC	3.42	1.17	1.0														
1494	3.80	IRC	*	-.20	-.2														
1495	9.30	IRC	5.55	1.69	.9	-.9			27/ 3/78	1.63	1.33	1.21	1.02	.75	.52	.32	.36		JAH
1497	5.03	IRC	3.48	1.14	.9														
1502	5.37	IRC	2.75	-.27	-.2				19/ 5/79	-.11	-.18	-.11	-.12	-.44	-.44	-.43	-.45		JAH
1502									26/ 5/79	-.18	-.30	.04	.36		-.04				GC
1503	6.46	IRC	4.09	1.28	1.0														
1547	6.66	IRC	4.39	1.60	1.2														
1549	9.10	DO	4.30	.73	-.1	-.9			8/ 3/78	.37	-.01	-.24	-.86	-1.06	-1.28	-1.23	-1.10		JAH
1550	5.81	IRC	3.89	1.24	1.1														
1551	4.37	IRC	3.53	1.91	1.3														
1552	5.61	IRC	4.08	1.59	1.3														
1555	4.95	IRC	2.99	.37	.1														
1558	2.66	IRC	*	.67	.5				19/ 5/79	.91	.86	.92	.79	.68	.81	.64			JAH
1555									18/ 4/80	.68	.61	.61	.61	.55	.50	.55	.55		RDG
1564	9.30	DO	5.46	.88	.5	-1.0													

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
1565			7.79	2.31	1.2	-.8			26/ 3/78	3.28	1.84	1.40	.61	.44	.04	-.07	.16		JAH
1566	5.71	IRC	3.65	.97	.6	-1.2													
4157	6.20	IRC	5.77	2.24	1.2				29/12/77	2.54	2.01	1.69	1.07	.86	.63	.60	.35		G&H
4157									18/ 4/80	2.01	1.49	1.25	.91		.59	.57	.21		RDG
4157									18/ 4/80	2.04			.92		.63				RDG
1618	6.92	IRC	4.08	1.02	.7														
1622	.96	IRC	*	1.62	1.3														
1624					1.1														
1631	4.68	IRC	2.80	.33	-.1				19/ 5/79	.38	.27	.39	.44	.34	.21	.24	-.78		JAH
1631									26/ 5/79	.52	.33	.72	.30		.32				GG
1633	6.00	IRC	5.70	.57	-.2	-1.1	-3.2		8/ 3/78	.03	-.29	-.73	-1.20	-1.40	-1.55	-1.63	-2.11	-2.17	JAH
1637	6.52	IRC	4.98	2.50	1.3														
1642	4.73	IRC	2.87	.42	.3				12/ 6/78	.41	.22	.42	.26	.19	.07	.10	-.19		RDG
1643	5.16	IRC	3.21	.64	.6				12/ 6/78	.63	.52	.79	.66	.58	.65	.68	1.05		RDG
1710			6.44	1.48	.4	-1.3			17/ 2/78	1.30	.52	.15	-.63	-.89	-1.24	-1.30	-1.91	-2.17	RDG
1711	5.74	IRC	4.18	1.94	1.3				4/ 6/77	1.86	1.67	1.90	1.65	1.63	1.62	1.49			BTA
1713					1.3														
1714	4.25	IRC	3.07	.97	.7		-2.9		19/ 5/79	.83	.76	.91	.83	.99	.64	.79			JAH
1714									17/ 4/80	.96	.85	1.05	.89	.89	.89	1.07	.97		RDG
1716	3.57	IRC	*	.61	.4				4/ 6/77	.66	.47	.64	.52	.49	.45	.42	-.20		BTA
1719	8.30	IRC	3.91	-.19	-.4	-1.2			20/12/77	.04	-.37	-.42	-.68	-1.19	-1.55	-1.65	-2.37	-2.40	G&H
1720	8.00	IRC	4.24	.33	0.0				20/12/77	.37	.03	.29	.03	-.42	-.82	-.70	-1.11		G&H
1765	8.70	IRC	4.14	.14	-.1	-1.3	-3.1		17/ 4/80	.15	-.15	-.02	-.49	-.95	-1.41	-1.34	-2.17		RDG
1772	5.17	IRC	3.60	1.07	.9	-1.2			17/ 4/80	1.05	1.01	1.19	1.04	.96	.91	.87	.69		RDG
1773	13.60	LWD	8.02	1.94	.6	-1.4	-2.6		17/ 2/78	2.66	1.34	.66	-.74	-1.12	-1.61	-1.59	-2.27	-2.51	RDG
1776	7.12	IRC	3.74	.37	.2				17/ 4/80	.28	.22	.31	.20	.26	-.06	-.02	.41		RDG
1777			6.11	1.75	1.2				26/ 3/78	1.82	1.23	.91	.49	.17	-.20	-.22	-.61		JAH
1787	3.60	IRC	2.48	.50	.1														
1790	7.12	IRC	3.30	-.39	-.9				18/ 4/80	-.53	-.74	-.50	-.78	-.85	-.98	-1.00	-1.01		RDG
1792	4.72	IRC	3.22	.81	.7				12/ 6/78	.81	.67	.81	.72	.72	.52	.51	.74		RDG
1851	7.50	IRC	5.19	1.95	1.2				18/ 4/80	1.96	1.76	2.10	1.88	1.84	1.62	1.73			RDG
1853	5.32	IRC	3.46	.85	1.0				18/ 4/80	.88	.72	1.00	.85	.80	.70	.63			RDG
1854	8.40	IRC	5.09	.84	.6														
4223	2.74	IRC	*	.62	.4														
1859	6.90	IRC	6.49	1.71	.9				26/ 5/79		1.46	1.51	.71		.41				GG
1862			9.44	3.10	.9	-1.4	-2.9		19/ 4/78	2.87	1.90	1.35	-.01	-.58	-1.15	-.84	-1.92	-1.94	RDG
1862									20/ 4/80	2.44	1.49	.88	-.34	-1.12	-1.61	-1.24	-2.10	-2.13	GG
1868	9.70	DO	4.77	.20	-.4	-1.4			4/ 4/78	.17	-.21	-.33	-.68	-.93	-1.84	-1.45	-1.73		RDG
1869			5.93	1.65	.6	-1.1	-3.0												
1872	6.80	IRC	4.59	1.45	1.1	-.7													
1873	7.30	IRC	4.41	1.19	.7														
1874	6.75	IRC	4.84	1.91	1.1	-.7													
1875			6.82	1.58	1.1				26/ 5/79	1.81	1.42	1.64	1.26		.70				GG
1876			6.09	1.19	1.0	-.8													
1879	4.90	IRC	2.98	.29	.3														
1880			6.34	1.29	.8														
1883	8.60	IRC	4.70	.92	.4														
1961	9.00	CASE	6.37	1.83	1.1	-1.3													
1964			6.51	1.59	1.3														
1965			8.59	2.75	1.2				26/ 5/79	2.19	1.76	1.58	1.18		.54				GG

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
1565	-20 242			T CRV	M	401.34	M6	H&B		12 34 32.00	-17 15 18.0	GCVS		FMO
1566	0 221	4807	2 2560	SVS 101306			M3	HR	7	12 35 49.30	2 7 46.5	SAO		FMO
4157	10 256	4808	7 2561	R VIR	M	145.64	M4E	HR	7	12 35 57.67	7 15 47.0	SAO		FMO
4157														
4157														
1618	50 227		47 2053	DO 34360			M6	DO		13 20 57.03	47 15 44.3	SAO		FMO
1622	-10 286	5056	-10 3672	ALF VIR	ELL	4.0141600	B1	IRC	5	13 22 33.30	-10 54 3.4	SAO		FMO
1624										13 25 31.00	40 7 36.0	AFGL		FMO
1631	-10 288	5095	-5 3714	74 VIR			M3	IRC	7	13 29 21.72	- 5 59 53.7	SAO		W49
1631														
1633	-10 290	5101	-6 3837	S VIR	M	377.43	M7E	HR	7	13 30 23.51	- 6 56 18.8	SAO		FMO
1637	50 25	5131	77 516	GC 18390			K5	IRC		13 34 2.27	76 48 5.9	SAO		FMO
1642	50 231	5154	55 1625	83 UMA			M2	HR	3	13 38 50.56	54 56 3.0	SAO	C	FMO
1643	-10 293	5150	-7 3674	82 VIR			M2	IRC	3	13 38 59.05	- 8 27 5.1	SAO		FMO
1710	0 243			RS VIR	M	352.80	M6E	GCVS		14 24 48.00	4 53 48.0	GCVS		FMO
1711	-10 306	5410	-6 4009	106 VIR			K5	IRC	7	14 26 3.24	- 6 40 37.2	SAO		FMO
1713										14 26 33.00	38 9 36.0	AFGL		FMO
1714	80 28	5430	76 527	5 UMI			K4	IRC	3	14 27 36.19	75 55 5.8	SAO		W49
1714														
1716	30 259	5429	31 2628	RHO BOO			K3	IRC	3	14 29 40.45	30 35 24.1	SAO		FMO
1719	30 261		33 2482	RV BOO	SRB	137.00	M6	DO		14 37 9.31	32 45 15.3	SAO		FMO
1720	30 262		32 2504	RW BOO	SRB	209.00	M7	DO		14 39 6.20	31 47 6.6	SAO		FMO
1769	0 265		-1 3054	DO 3724			M7	DO		15 22 19.36	- 2 3 34.5	SAO		FMO
1772	20 280	5739	15 2858	TAU1 SER			M1	IRC	3	15 23 28.12	15 36 9.7	SAO		FMO
1773	20 281			UX SER	M	425.10	M8	LWD	7	15 25 34.00	19 44 6.0	GCVS	C	FMO
1776	-20 288		-23 12359	GC 20870			M3	IRC		15 29 17.81	-23 42 40.9	SAO		FMO
1777	0 268			WW SER	M	366.60	M8	H&B		15 29 57.00	3 48 18.0	GCVS		W49
1787	-30 239	5794	-27 10464	UPS LIB			K5	IRC	3	15 33 58.97	-27 58 15.4	SAO		FMO
1790	20 283		24 2901	DO 15290			M2	DO		15 36 7.74	24 41 4.3	SAO		FMO
1792	-20 292	5838	-19 4188	KAP LIB			K5	IRC	3	15 39 3.64	-19 31 5.6	SAO		FMO
1851	-10 338		-6 4419				MB	IRC		16 20 18.07	- 7 5 35.7	SAO		FMO
1853	30 288	6107	34 2773	NU1 CRB			M2	IRC	7	16 20 28.37	33 54 56.3	SAO		FMO
1854	-20 315		-22 11524				M3	IRC		16 20 53.45	-22 15 12.8	SAO		FMO
4223	60 242	6132	61 1591	ETA DRA			G8	IRC	3	16 23 18.46	61 37 37.6	AGK3		FMO
1859	-10 339		-12 4510	V OPH	M	297.99	C6E	GCVS		16 23 56.58	-12 18 54.7	SAO		W49
1862	30 292						M9	VOGT		16 25 59.00	34 54 36.0	IRC	C	FMO
1862														
1868	70 135			R UMI	SRA	324.40	M7	DO		16 30 40.00	72 22 48.0	GCVS	C	FMO
1869	-20 319			T OPH	M	366.69	M6E	GCVS		16 30 54.00	-16 1 48.0	GCVS		FMO
1872	60 243		60 1688	TX DRA	SRB	78.00	M7	DO		16 34 17.45	60 34 9.7	SAO		FMO
1873	20 303		22 2958	DO 15566			M6	DO		16 35 29.74	22 32 38.3	SAO		FMO
1874	-10 344		-8 4282	GC 22375			K5	IRC		16 36 4.57	- 8 31 13.1	SAO		FMO
1875	-20 321						M6	H&B		16 36 16.00	-21 46 24.0	IRC		W49
1876	-20 322						M6	H&B		16 36 43.00	-20 46 54.0	IRC		FMO
1879	50 253	6200	49 2531	42 HER			M2	HR	7	16 37 23.25	49 1 31.3	SAO		FMO
1880	-20 324						M?	H&B		16 38 19.00	-19 52 6.0	IRC		FMO
1883	-30 269		-26 11477	AX SCO	SR	138.00	M5	IRC		16 38 43.89	-27 0 37.0	SAO		FMO
1961	-30 293		-29 13477				C	H&B		17 20 50.00	-29 16 54.0	IRC		FMO
1964	-30 294						M6	H&B		17 22 27.00	-26 48 24.0	IRC		FMO
1965	0 303			AH OPH	M	353.20	M7	H&B		17 23 0.00	- 3 1 42.0	GCVS		W49

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
1966	70 139		71 841	DO 35751			M6	DO		17 24 3.36	71 54 48.4	SAO		FMO
1967	20 323	6495	17 3241	V640 HER			M4	HR	7	17 23 40.75	16 57 35.3	SAO		FMO
1969	0 304	6496	4 3422	SIG OPH			K3	IRC	2	17 24 1.90	4 10 56.1	SAO		FMO
1971	-20 364			TW OPH	SRC	185.00	C6	GCVS		17 26 48.00	-19 26 12.0	GCVS	C	FMO
1974	-30 301						>M7	H&B		17 27 19.00	-26 43 6.0	IRC		FMO
1976	30 307	6526	26 3034	LAM HER			K4	IRC	3	17 28 42.95	26 8 49.5	SAO		FMO
1983	0 307			DO 4308			M7	H&B		17 31 23.00	- 1 57 0.0	IRC		FMO
1985	-20 370						M7	H&B		17 31 47.00	-23 41 54.0	IRC		W49
1987	50 267			SY DRA	M	390.50	M7E	GCVS		17 33 7.00	53 59 54.0	GCVS		FHO
1993	60 251			TY DRA	LB		M8	DO		17 36 13.00	57 45 42.0	GCVS		FKO
1995	0 313	6578	-2 4425	DO 4452			M4	HR	7	17 37 35.66	- 2 7 36.2	SAO		FMO
1996	-20 378						M8	H&B		17 38 56.00	-20 46 6.0	IRC		FMO
1998	0 315		-4 4332	GC 24016			M0	IRC		17 39 55.71	- 4 49 36.2	SAO		FHO
2137	20 362	6882	23 3316	GC 25082			M1	DO	7	18 20 3.48	23 15 30.5	SAO		FMO
2138	50 279	6891	49 2782	DO 36186			M2	HR	7	18 20 15.81	49 5 44.0	SAO		FMO
2142	0 349			SVS 4075			M9	VOGT		18 21 22.00	3 35 30.0	SVS		W49
2146	40 315			TW LYR	M	376.63				18 22 18.00	39 33 0.0	GCVS		FMO
2149	-20 478	6896	-20 5134	21 SGR			K2	IRC	2	18 22 22.29	-20 34 12.9	SAO		FMO
2150										18 23 2.20	5 44 16.0	KLKM		FMO
2156	0 350		3 3713	V988 OPH	SR	63.20	M7	DO		18 24 23.52	3 52 57.0	SAO		FMO
2158	0 351			DO 4822			C	H&B		18 24 26.00	1 7 6.0	IRC		FMO
2159	10 357			V585 OPH	SRB	135.00	M6	DO		18 24 45.00	7 29 24.0	GCVS		FMO
2163	-30 386	6913	-25 13149	LAM SGR			K2	IRC	3	18 24 53.06	-25 27 4.2	SAO		FMO
2164	-10 424		-8 4612				M4	H&B		18 25 1.00	- 8 42 24.0	IRC	C	W49
2166	-10 425						M5	H&B		18 25 17.00	-13 5 0.0	IRC	C	FMO
2167	-20 467						M8	H&B		18 26 7.00	-17 49 6.0	IRC		FMO
2168	-10 426									18 26 16.00	-11 34 6.0	IRC	C	FMO
2173										18 27 44.00	- 1 24 12.0	AFGL		FMO
2179										18 28 56.50	-10 1 24.0	JYCE		FMO
2180	0 353			TY OPH	LB		C	H&B		18 28 55.00	4 20 30.0	GCVS		FMO
2181	40 320		38 3200	KP LYR	SRB	146.00	M8	DO		18 29 11.02	38 36 13.8	SAO		FMO
2182	-10 433	6959	-14 5099	GC 25310			C	H&B	6	18 29 51.90	-14 54 12.5	SAO		W49
2186	-10 435		-14 5105	HD 171094			M3	LWD	7	18 30 32.58	-14 8 46.5	SAO		FMO
2187	40 321		36 3168	T LYR	LB		N	DO		18 30 36.19	36 57 38.9	SAO		FMO
2189										18 31 23.00	14 12 6.0	AFGL		FMO
2192										18 31 29.00	-11 31 47.0	LKVR		FMO
2192														
2192														
2196	-20 497		-19 5077				M3	IRC		18 32 26.62	-19 18 33.7	SAO		FMO
2197	-10 438	6973	-8 4638	ALF SCT			K3	IRC	3	18 32 29.11	- 8 16 50.5	SAO		FMO
2198	50 282		51 2404				M5	DO		18 33 21.11	51 44 29.3	SAO		FMO
2201	-20 500						M5	H&B		18 33 47.00	-19 56 24.0	IRC		W49
2203	-10 441		-7 4633	RX SCT	LB		C	H&B		18 34 22.00	- 7 39 54.0	GCVS	C	FMO
2204	0 359		-2 4676	CZ SER	LB		M6	H&B		18 34 45.00	- 2 42 0.0	GCVS		FMO
2208	40 322	7001	38 3238	ALF LYR			A0	IRC	5	18 35 14.66	38 44 9.7	SAO	C	FMO
2215	-20 505		-15 5043	GC 25494	I	334.39	K5	IRC		18 36 11.04	-15 5 4.2	SAO	C	FMO
2217	40 323	7009	39 3476	XY LYR	LC		M4	HR	6	18 36 27.28	39 37 22.8	SAO		FMO
2218	20 369		18 3763	DO 16917			M6	DO		18 36 31.72	18 22 33.6	SAO		FMO
2219	10 367		11 3548				M5	DO		18 37 17.62	11 48 52.6	SAO		FMO
2224										18 37 53.00	-25 46 48.0	AFGL		FMO

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.0	23.0	OBSVR
1968	7.05	IRC	4.31	.90	.7														
1967	6.12	IRC	3.61	.49	.2														
1969	4.34	IRC	3.10	1.00	.7														
1971			4.69	.26	-.3	-.9			11/ 8/80	.58	-.07	.76	-.59	-.70	-.79	-.59	-1.00		GG
1974			8.01	1.54	1.2														
1976	4.41	IRC	3.19	1.10	1.1														
1983	12.00	DO	6.31	1.74	1.1		-2.3												
1985			6.68	1.58	.9	-1.3			26/ 5/79	1.76	1.36	1.60	.92		.12				GG
1987			7.05	2.48	1.1	-.6	-2.4												
1993	9.80	DO	5.00	.91	.5	-1.0	-3.0		4/ 8/78	.85	.48	.75	.24	-.57	-1.11	-.77			RDG
1995	6.44	IRC	4.15	1.23	.7														
1996			7.97	3.00	.9	-1.4													
1998	6.79	IRC	4.41	1.28	1.1														
2137	10.80	DO	3.85	1.37	.9														
2138	5.05	IRC	3.23	.62	.4														
2142			8.25	2.35	.9	-.6	-3.1		26/ 5/79	2.87	2.78	2.99	2.93						GG
2146			5.36	1.68	1.1	0.0			4/ 8/78	1.79	1.06	.90	.44	-.01	-.26	-.51			RDG
2149	4.81	IRC	3.56	1.28	1.1		-3.4												
2150					.9	-1.4													
2156	8.20	IRC	4.35	.66	.4														
2158	12.50	DO	8.26	2.25	1.1				24/ 5/80	2.33	1.60	2.05	.81	.71	.45	.45			GG
2159	10.90	DO	5.83	1.42	.9														
2163	2.84	IRC	*	.47	.5														
2164			6.65	2.10	1.1	-.9			20/ 4/80	2.12	1.84	2.07	1.93	1.72					GG
2166			7.17	2.04	1.2	-.9													
2167			6.13	1.35	.6														
2168			8.94	2.73	1.2	-1.0	-2.8												
2173					1.3														
2179					1.0	-.4													
2180			6.47	1.80	1.0														
2181	8.60	IRC	5.76	2.07	1.2	-1.1			17/ 8/78	2.21	1.87	2.03	1.92	1.66	1.48	1.39			RDG
2182	5.88	IRC	3.69	1.02	.9				20/ 4/80	1.10	.86	1.13	.77	.72	.84				GG
2186	9.00	IRC	5.20	1.72	1.1	-1.2													
2187	7.80	IRC	4.89	.45	-.5	-1.3													
2189					.4														
2192					1.3	-1.3			23/ 6/78	3.64	2.02	1.28	-.30	-.80	-1.20	-1.18			RDG
2192									30/ 8/79	2.65	1.47	.88		-1.18					RDG
2192									16/ 4/80	3.72	1.89	1.04	-.43	-.91	-1.38	-1.35	-2.01		RDG
2196	7.19	IRC	3.93	.72	.7		-3.6												
2197	3.84	IRC	2.73	.87	.8														
2198	6.71	IRC	4.48	1.49	1.1				11/ 8/80	1.66	1.39	1.65	1.46	1.45	1.32	1.17	1.20		GG
2201			5.86	1.89	1.3				21/ 5/80	1.84	1.68	1.77	1.53	1.65	1.29	1.42	1.17		RDG
2203			6.22	1.74	1.0	-1.4	-3.0		11/ 8/80	1.86	1.29	1.56	.92	.81	.73	.55	.40		GG
2204	10.10	DO	5.73	1.04	.4	-.5													
2206	.04	IRC	*	-.06	-.4	-.6				-.02	-.03	-.03	-.03	-.03	-.03	-.03	-.03	-.03	
2215	7.75	IRC	5.11	1.93	1.2	-.4													
2217	5.80	IRC	2.95	-.35	-.6	-1.2													
2218	9.00	IRC	5.71	2.00	1.1														
2219	10.40	DO	5.88	1.72	.9														
2224					1.2														

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
2225	40 324		40 3449	DO 16943			M6	DO		18 38 21.65	40 17 2.3	SAO		W49
2230	0 364						M7	LWD	7	18 39 32.00	- 2 48 0.0	IRC	C	FHO
2382	-10 511		-13 5345				M3	IRC		19 22 19.34	-13 32 17.8	SAO		FHO
2384	80 36		76 734	UX DRA	SRA	168.00	N	DO		19 23 22.41	76 27 41.7	SAO		FHO
2391	-20 563						M8	H&B		19 24 49.00	-17 22 24.0	IRC		FHO
2392							C2	CK2		19 24 49.00	6 57 36.0	LKRL		FHO
2395	20 407	7405	24 3759	ALF VUL			M0	IRC	3	19 26 37.41	24 33 44.9	SAO		FHO
2396	50 295			AW CYG	SRB	220.00	N	DO		19 27 17.00	45 56 0.0	GCVS		FHO
2400	0 438			V374 AQL	IS		N	DO		19 27 40.00	- 0 56 12.0	GCVS		W49
2404	50 296			DO 37347			N	DO		19 28 35.00	48 53 48.0	IRC		FHO
2406	30 370	7417	27 3410	BET CYG			K5?	IRC	2	19 28 42.22	27 51 12.4	SAO		FHO
2407	50 297		45 2913	AF CYG	SRB	94.10	M8	DO		19 28 42.96	46 2 31.7	SAO		FHO
2412	0 443		4 4152	V1293 AQL			M7	DO		19 30 39.37	4 55 14.6	SAO		FHO
2415	10 428		5 4190	V450 AQL	SRB	4.00	M7	DO		19 31 18.04	5 21 23.9	SAO		FHO
2416	-20 568		-16 5360	AQ SGR	SRB	199.60	C5	GCVS		19 31 27.10	-16 29 2.2	SAO		FHO
2418	50 300	7442	48 2914	DO 37447			M4	HR	7	19 32 18.94	49 9 9.8	SAO		FHO
2420	30 376		33 3507	GC 27069			M0	IRC		19 33 3.16	33 41 4.0	SAO		W49
2422	50 301		49 3064	R CYG	M	426.44	S5	GCVS		19 35 28.69	50 5 11.5	SAO		FHO
2424	70 159		69 1058	DO 37579			M5	DO		19 35 35.91	69 41 33.6	SAO		FHO
2423	10 433			RT AQL	M	329.50	M6	DO		19 35 40.00	11 36 18.0	GCVS		FHO
2426	30 379			BG CYG	M	291.28	M7	DO		19 37 0.00	28 23 30.0	GCVS	C	FHO
2428							C3	CK1		19 38 7.60	33 15 27.0	JYCE		FHO
2428														
2428														
2428														
2428														
2429	40 355			V462 CYG	M	199.20				19 38 27.00	43 46 36.0	GCVS		FHO
2430	0 448		-4 4880	DO 6039			M6	DO		19 38 29.56	- 4 2 11.5	SAO		FHO
2432	30 382		32 3522	TT CYG	SRB	118.00	R	DO		19 39 1.90	32 30 2.2	SAO		W49
2434	20 427	7488	17 4048	BET SGE			G8	IRC	2	19 38 48.13	17 21 32.0	SAO		FHO
2435	40 356	7492	42 3419	DO 37608			M2	HR	7	19 39 3.89	42 57 36.9	SAO		FHO
2568	0 474			V865 AQL	M	364.80	M6	H&B		20 21 22.00	0 46 54.0	GCVS		FHO
2570	60 288						M9	VOGT		20 21 31.00	62 43 48.0	IRC	C	FHO
2571	30 430	7806	31 4062	39 CYG			K3	IRC	3	20 21 51.68	32 1 39.9	SAO		FHO
2574										20 24 1.00	- 2 12 42.0	AFGL		FHO
2577	-10 539		-6 5487				M8	IRC		20 25 6.95	- 5 49 12.7	SAO		W49
2580	40 418			V441 CYG	SRA	375.00	M5	DO		20 25 14.00	36 23 6.0	GCVS		FHO
2581	80 40		74 861	UU DRA	SRB	120.00	M7	DO		20 24 53.88	75 5 22.1	SAO		FHO
2582	60 291			V372 CYG	SRA	308.00	M6	DO		20 25 25.00	55 34 0.0	GCVS		FHO
2583	40 420			KZ CYG	M	406.30	M3	DO		20 25 36.00	40 54 12.0	GCVS	C	FHO
2585	40 422		37 3946	SVS 103001			M7	DO		20 26 36.06	37 37 21.0	SAO		FHO
2586	20 470		15 4172	RS DEL	SRB	60.00	M8	DO		20 26 51.23	16 6 21.7	SAO		FHO
2589	10 470		9 4549	CT DEL	LB		M7	DO		20 27 1.82	9 43 49.0	SAO		FHO
2592	0 477		-5 5288	TZ AQL	LB		MC	IRC		20 27 40.20	- 4 55 22.7	SAO		W49
2597	30 437		32 3850	AD CYG	LB		MP	IRC		20 29 36.43	32 23 40.3	SAO		FHO
2598	50 331	7851	48 3154	OME2 CYG			M2	HR	7	20 29 46.15	49 3 3.0	SAO		FHO
2601	40 429			V397 CYG	LB		M2	DO		20 30 16.00	35 16 54.0	GCVS		FHO
2604				W 72						20 31 9.00	42 22 24.0	LKRL		FHO
2606	50 333		53 2435	DO 38576			M3	DO		20 31 46.05	54 17 6.6	SAO		FHO
2607	40 432			CIT 10						20 31 50.00	38 30 0.0	IRC		FHO

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
2225	6.40	IRC	5.16	1.56	1.2	-.9			18/ 4/80	1.62	1.43	1.57	1.35	1.29	1.19	1.27	.99	1.21	RDG
2230	13.30	LWD	8.57	2.16	1.2														
2382	7.60	IRC	5.12	1.84	1.3														
2384	5.80	IRC	3.85	.18	-.1	-.6													
2391			6.00	.87	.3	-1.3													
2392	15.20	CK1			.8	-1.1													
2395	4.41	IRC	2.89	.57	.2	.1													
2398	8.10	DO	6.19	2.02	1.1	-.6													
2400	11.10	DO	8.90	2.67	.5	-1.3			26/ 5/79	2.52	1.40	1.08	.22		-.42				GG
2404	11.10	DO	6.53	1.73	1.2														
2406	3.09	IRC	*	.11	-.1	-.9													
2407	6.40	IRC	3.63	.29	-.2	-1.0													
2412	6.82	IRC	3.97	.78	.5		-2.8												
2415	6.73	IRC	3.24	.14	-.3														
2416	8.50	IRC	4.74	.78	.1	-1.1													
2418	6.06	IRC	3.63	.65	.4														
2420	6.73	IRC	4.60	1.50	1.3				26/ 5/79	1.51	1.35	1.70	1.45		1.51				GG
2422	5.60	IRC	4.64	1.90	.8	-1.1	-2.9												
2424	7.10	IRC	4.10	.82	.4		-3.7												
2423			6.54	1.40	.3	-1.4													
2426	11.20	DO	5.97	1.08	.3	-.9													
2428	15.40	CK1			1.1	-1.0			12/ 6/78	4.86	2.71	1.60	.35	.09	-.14	-.21	-.39		RDG
2428									22/ 6/78	4.81	2.59	1.44	.32	.15	-.18	-.01			RDG
2426									4/ 8/78	4.80	2.59	1.08	.21	-.04	-.46	-.39	-.39		RDG
2428									27/ 7/79	5.04	2.82	1.69	.39	.11	-.11	.01	-.24		RDG
2428									18/ 4/80	3.55	1.62	.53	-.35	-.54	-.94	-.79	-1.01		RDG
2429			6.14	1.71	1.2														
2430	6.00	IRC	4.67	.90	.8														
2432	8.00	IRC	5.52	1.93	1.0				26/ 5/79	1.78	1.22	1.48	.91		1.18				GG
2434	4.37	IRC	3.63	2.09	1.0	-.5													
2435	6.22	IRC	4.34	1.51	1.2														
2568	9.60	DO	5.44	1.52	1.1														
2570			7.72	2.56	1.2														
2571	4.40	IRC	3.34	1.38	1.1	-.8													
2574					1.3														
2577	7.30	IRC	4.40	1.26	1.1		-2.4		20/ 5/80	1.24	1.12	1.30	1.03	.97	.92	.95	.74		RDG
2580	10.20	DO	5.94	1.73	1.2														
2581	9.40	IRC	4.89	.38	-.1	-1.2													
2582	11.50	DO	6.29	1.80	1.3														
2583	10.50	DO	7.12	1.84	1.1	-.7			17/ 8/78	1.53	.97	.89	.46	-.02	-.31	-.47	-.62		RDG
2585	7.50	IRC	5.08	1.80	1.2														
2588	8.10	IRC	4.26	.50	.1	-.9			17/ 8/78	.43	.17	.35	.08	-.15	-.28	-.15	-.74		RDG
2589	7.80	DO	4.30	1.07	.7			-6.4	17/ 8/78	.99	.72	.97	.56	.35	.08	.25	-.41		RDG
2592	9.00	IRC	5.15	1.12	.7	-.8			20/ 5/80	1.14	.97	1.06	.55	-.04	-.50	-.12	-.84		RDG
2597	9.10	IRC	5.00	1.24	.9														
2598	5.42	IRC	3.85	1.25	1.2														
2601	11.20	DO	6.83	1.83	1.1	-.8	-3.1		24/10/78	1.74	1.32	1.45	1.14	.85	.39	.43	-.11		JAH
2604					1.3	-1.3													
2606	7.06	IRC	4.84	1.90	1.1														
2607			8.07	2.26	1.0	-.7													

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC. 1950.00	SOURCE	COMMENT	CLASS
2608	40 433	7866	34 4079	47 CYG			K5	HR	2	20 31 57.39	35 4 43.3	SAO		FHO
2610	-10 541						M6	H&B		20 32 19.00	- 7 37 6.0	IRC		FHO
2613										20 34 4.40	53 38 57.0	G&H		W49
2614	0 483	7873	-3 4961	70 AQL			K4	IRC	3	20 34 7.41	- 2 43 27.2	SAO		FHO
2617	40 435						M9	VOGT		20 35 3.00	37 42 6.0	IRC	C	FHO
2623	-20 592	7900	-18 5738	UPS CAP			M2	IRC	3	20 37 12.31	-18 18 57.8	SAO		FHO
2626	40 439			CIT 11			S	CASE		20 37 43.00	39 1 30.0	IRC		FMO
2627	50 336			V1202 CYG	LB		M5	DO		20 37 38.00	53 21 0.0	IRC		FMO
2633	50 337	7924	44 3541	ALF CYG			A2	IRC	2	20 39 43.54	45 6 3.1	SAO		FHO
2753	-20 600	8172	-23 16677	GC 29923			M1	IRC	7	21 20 8.71	-22 53 .4	SAO		W49
2754	20 506			SW PEG	M	396.33	M4E	GCVS		21 20 12.00	21 46 54.0	GCVS		FHO
2755	40 478			YY CYG	SRA	388.00	R	DO		21 20 33.00	42 10 42.0	GCVS		FHO
2759	40 479		40 4502	V1070 CYG	SR?		M7	DO		21 20 51.73	40 43 6.1	SAO		FHO
2761	80 47		79 702	DO 39574			M7	DO		21 21 31.73	79 33 12.3	SAO		FHO
2764	-20 602	8204	-22 15388	ZET CAP			G4P	HR	2	21 23 48.94	-22 37 44.3	SAO		FHO
2765	60 317		61 2134	SW CEP	SRB	70.00	M6	DO		21 24 32.33	62 21 24.9	SAO		FHO
2767	60 318	8224	59 2383	GC 30065			M1	IRC		21 26 2.40	59 31 55.0	SAO		W49
4275										21 26 17.00	- 2 58 6.0	AFGL		FHO
2769	20 511	8223	21 4555	SVS 102104			M4	IRC	7	21 26 42.61	21 57 36.1	SAO		FMO
2768	70 170			AX CEP	M	395.00	M	DO		21 26 10.00	70 0 6.0	GCVS		FHO
2771	70 171						M5	VOGT		21 26 59.00	71 36 6.0	IRC	C	FHO
2772	20 512	8225	23 4325	2 PEG			M1	IRC	3	21 27 40.86	23 25 7.7	SAO		FHO
2776	-10 565	8232	-6 5770	BET AQR			G0	IRC	2	21 28 55.65	- 5 47 31.7	SAO		FHO
2779	50 383						M7	CASE		21 31 13.00	54 5 48.0	IRC		FMO
2782	0 504		1 4503	DO 7488			M6	DO		21 32 10.16	1 36 21.4	SAO		FHO
2784	30 476		31 4504	AB CYG	SRB	520.00	M8	DO		21 34 24.51	31 52 39.0	SAO		W49
2783	40 468	8264	42 4177	75 CYG			M0	HR	3	21 38 13.14	43 2 46.2	SAO		FHO
2792	10 502	8259	5 4850	7 PEG			M2	HR	7	21 39 45.35	5 27 5.3	SAO		FHO
2793	40 489	8297	34 4500	V460 CYG	LB		C6	HR		21 39 54.35	35 16 53.3	SAO		FHO
2794	50 392	8298	45 3637	V1339 CYG	SRB?	35.00	M4	HR		21 40 13.52	45 32 13.9	SAO		FHO
2593	-20 618		-22 15866	RT AQR	M	246.30	M5	IRC		22 20 27.64	-22 18 35.6	SAO		FHO
2895	30 491		30 4703	DO 21445			M5	DO		22 21 39.17	31 0 29.6	SAO		FMO
2896	60 353		55 2737	RW CEP	LC		M0	DO		22 21 13.98	55 42 36.3	SAO		FHO
2908	40 511			DO 21501			M6	DO		22 26 1.00	35 18 6.0	IRC		W49
2910	60 355			DO 41440			M6	DO		22 26 26.00	58 58 36.0	IRC		FHO
2912	50 432		49 3864	DO 41442			M4	DO		22 26 43.06	49 52 55.4	SAO		FHO
2913	50 433	8572	46 3719	5 LAC			M0	IRC	2	22 27 26.54	47 27 1.7	SAO		FHO
2916	60 357		56 2793	ST CEP	LC		M3	DO		22 28 16.47	56 44 38.9	SAO		FHO
2918	50 435		52 3237	DO 41530			M3	DO		22 30 23.14	52 58 .6	SAO		FHO
2919	60 359			HY LAC			M7	LWD	7	22 30 40.00	55 10 54.0	IRC		FHO
2921	20 532			SS PEG	M	416.35	M7	DO		22 31 36.00	24 18 18.0	GCVS		FHO
2324										22 34 9.00	- 9 0 42.0	AFGL	C	W49
2928	60 363	8621	56 2821	SVS 102195			M4	HR	7	22 36 39.53	56 32 8.1	SAO		FHO
2931	40 515		39 4909	DO 41747			M5	DO		22 37 51.77	40 24 33.7	SAO		FHO
2932	50 440			CI LAC	SRB		M8	VOGT		22 38 35.00	49 44 30.0	IRC		FHO
2934	20 534			BC PEG	SRB	125.00	M6	DO		22 39 23.00	20 54 30.0	GCVS		FHO
2935	-10 585		-5 5843	GC 31678			M0	IRC		22 39 29.94	- 5 21 47.9	SAO		FHO
3023	-10 598			SV AQR	LB		M8	H&D		23 20 9.00	-11 5 30.0	GCVS		FHO
3085	60 402			V398 CAS	LB		M5	DO		23 20 13.00	59 2 42.0	GCVS		FHO
3087	60 401	8894	59 2710	DO 42962			K5	HR	2	23 20 18.07	59 51 32.7	SAO		FHO

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
2608	4.63	IRC	3.07	.72	.5														
2610			6.30	1.53	1.0														
2613					1.2	-.6			25/10/75	4.04	1.74	.08	-.35	-.55	-.77	-.70	-.72		G&H
2614	5.22	IRC	3.45	1.21	.7														
2617			8.47	2.37	1.1	-1.3													
2623	5.10	IRC	3.32	.74	.6														
2625	13.80	LWD	8.71	1.70	1.0				25/ 6/78	1.75	1.11	1.14	.63	.04	-.37	-.46			GG
2627	11.00	DO	6.55	2.20	1.3														
2633	1.26	IRC	*	.84	.6	-.9			24/10/78	.84	.69	.74	.57	.74	.50	.52			GG
2753	5.60	IRC	4.12	1.52	1.2				21/ 5/80	1.47	1.41	1.60	1.45	1.49	1.34	1.51			RDG
2754			8.31	2.46	1.2				17/ 8/78	2.41	1.78	1.74	1.29	1.00	.78	.71	.42		RDG
2755	9.50	DO	7.15	2.61	1.0														
2759	7.28	IRC	3.13	-.66	-.8														
2761	8.70	IRC	6.18	2.43	1.3														
2764	3.73	IRC	3.04	1.87	1.2														
2765	8.00	IRC	5.63	1.73	1.1	-1.4													
2767	6.24	IRC	3.88	.98	.6				21/ 5/80	.92	.75	.98	.80	.71	.65	.62	.38		RDG
4275					1.3														
2769	5.93	IRC	3.06	-.23	-.5	-.2													
2768	12.20	DO	8.23	2.46	.5	-1.3													
2771			8.07	2.32	1.1	-1.3	-2.9												
2772	4.55	IRC	2.89	.52	.2														
2776	2.89	IRC	*	1.12	.8														
2779			5.70	.66	.2	-1.2													
2752	6.75	IRC	3.61	.39	0.0	-.7													
2764	7.80	IRC	5.38	1.93	.9				21/ 5/80	1.84	1.61	1.79	1.24	.49	.02	.25	-.66		RDG
2785	6.20	IRC	3.51	.98	.6														
2792	5.29	IRC	3.51	1.04	.8		-3.2												
2793	6.03	IRC	3.85	.23	-.4														
2794	6.47	IRC	3.43	.19	0.0														
2893	9.20	IRC	6.19	2.18	1.2														
2895	7.46	IRC	4.28	.92	.4														
2896	6.80	IRC	4.74	1.92	1.2	-1.4	-3.5												
2908	10.20	DO	5.83	1.71	1.3				21/ 5/80 °	1.67	1.34	1.48	1.05	.78	.64	.47	.11		RDG
2910	11.20	DO	7.30	2.16	1.1	-1.1													
2912	8.90	IRC	5.88	2.28	1.1														
2913	4.37	IRC	*	.10	-.1														
2915	8.10	IRC	5.41	1.80	.9	-1.0													
2918	9.30	IRC	5.27	1.30	1.0														
2919			5.73	1.11	.7	-1.2													
2921			5.90	1.00	.4	-.3													
2924					.8														
2928	5.23	IRC	2.69	-.22	-.5	-.4													
2931	7.07	IRC	4.77	1.68	1.5														
2932			6.25	1.74	1.1														
2934	9.40	DO	5.90	1.79	1.3	-.7			17/ 8/78	1.81	1.45	1.56	1.17	.76	.44	.38	-.17		RDG
2935	7.04	IRC	3.80	.87	.6														
3083			5.60	1.04	.6	-.7			21/11/78	1.22	.86	.79	.36	.09	-.40	-.29	-.84	-.37	RDG
3065	6.50	DO	5.79	1.52	.7	-1.0			17/ 8/78	1.47	.80	.88	.02	-.24	-.70	-.60	-.84		RDG
3087	5.55	IRC	4.15	1.72	1.3	-.5			21/11/78	1.59	1.43	1.55	1.70	1.62	1.55	1.68			RDG

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
3086	-20 633	8892	-20 6587	98 AQR			K0	IRC	3	23 20 20.78	-20 22 25.5	SAO		W49
3086														
3088	40 536			BU AND	M	382.50				23 21 14.00	39 27 6.0	GCVS		FMO
3089	0 530		2 4664	DO 7994			M4	DO		23 22 1.64	3 26 22.3	SAO		FMO
3090										23 21 51.00	- 2 6 30.0	AFGL		FMO
3091	60 404	8904	61 2444	4 CAS			M1	HR	3	23 22 36.33	62 0 29.3	SAO		FMO
3093	-20 635	8906	-21 6420	99 AQR			K5	IRC	3	23 23 25.30	-20 54 58.5	SAO		FMO
3094	50 464		52 3440	DO 43042			M7	DO		23 23 15.94	52 42 16.9	SAO		FMO
4297										23 24 12.00	27 18 36.0	AFGL		FMO
4298										23 26 40.00	11 16 12.0	AFGL		FMO
3101	40 538		37 4852	DO 22260			M6	DO		23 27 9.48	38 22 3.9	SAO		FMO
3104	50 466		50 4056	DO 43142			M7	DO		23 27 9.10	51 24 34.6	SAO		W49
3107	60 408		58 2602	DO 43171			M7	DO		23 27 49.03	59 8 43.6	SAO		FMO
3113	20 550	8940	21 4952	71 PEG			M5	HR	7	23 30 57.62	22 13 21.5	SAO		FMO
3115	20 551	8942	20 5352	DO 22300			M3	HR	7	23 31 24.79	20 33 52.6	SAO		FMO
3118										23 32 23.00	- 5 34 30.0	AFGL		FMO
3120	20 552	8953	23 4769	GC 32814			M1	IRC		23 33 25.58	24 17 3.3	SAO		FMO
3122	50 471	8961	45 4283	LAM AND	SPBI	55.82	G8	IRC	3	23 35 6.52	46 11 13.8	SAO	C	FMO
3123										23 35 6.00	- 5 0 24.0	AFGL		FMO
3124	60 415						M8	CASE		23 36 1.00	61 38 0.0	IRC		W49
3126	30 515			SVS 8872			M7	LWD	7	23 36 54.00	32 3 36.0	SVS	C	FMO
3127	80 57	8974	76 928	GAM CEP			K1	IRC	4	23 37 16.53	77 21 11.7	SAO		FMO
3131										23 39 47.00	18 10 0.0	AFGL		FMO
3133	60 416	8989	63 2038	GC 32927			M2	IRC	3	23 39 58.45	64 14 17.4	SAO		FMO

CL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
3086	3.95	IRC	3.09	1.38	1.1				21/11/78	1.25	1.19	1.12	1.16	1.25	1.05	1.47			RDG
3086									21/ 5/80	1.29	1.31	1.33	1.20	1.29	1.14	1.17	.97		RDG
3088			5.38	.83	-.1	-1.0			17/ 8/78	.48	-.06	-.23	-.81	-1.04	-1.39	-1.34	-1.71		RDG
3089	8.80	IRC	5.60	2.05	.9														
3090					1.0														
3091	4.96	IRC	3.28	.77	.4	-.3			21/11/78	.71	.50	.75	.55	.51	.45	.55	.28		RDG
3093	4.40	IRC	3.12	.95	1.1	-1.3			21/11/78	.90	.95	.91	.72	.91	.67	.71			RDG
3094	6.94	IRC	4.64	1.83	1.2														
4297					1.1														
4298					1.0														
3101	7.50	IRC	5.34	2.33	1.3														
3104	8.20	IRC	4.98	1.67	1.3	-.4			21/ 5/80	1.74	1.56	2.01	1.55	1.46	1.35	1.42			RDG
3107	8.00	IRC	5.79	2.12	1.2				21/11/78	2.03	1.83	1.91	1.77	1.85	1.61				RLG
3113	5.34	IRC	2.78	-.33	-.4	-1.2													
3115	6.08	IRC	3.91	.99	.9	-1.3													
3118					.2														
3120	6.40	IRC	4.69	1.86	1.2														
3122	3.88	IRC	2.91	1.25	1.1														
3123					.3														
3124			6.96	2.26	1.3				21/ 5/80	2.21	1.81	1.80	1.33	1.01	.72	.63	.55		RDG
3126	10.40	DO	5.65	1.03	.6	-1.2													
3127	3.22	IRC	*	.89	.7	-.7													
3131					1.3														
3133	6.61	IRC	4.44	1.51	1.2														

TABLE 2

WIRO CATALOG OF AFGL SOURCES

LONG LAMBDA SUBCATALOG

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
57	60 9		54 48	T CAS	M	444.78	M8	DO		0 20 31.21	55 30 56.2	SAO		LL
59	40 9	90	37 58	R AND	M	409.16	S6E	HR		0 21 23.03	33 18 2.3	SAO		LL
67							K7	CK2		0 24 47.00	69 22 16.0	LSKR		LL
85										0 32 57.00	-11 46 0.0	AFGL	C	LL
230										1 30 27.20	62 11 31.0	KLMN		LL
230														
326				W 3						2 21 53.20	61 52 21.0	MGSB	C	LL
328				W 3 N						2 23 10.00	62 3 6.0	AFGL	C	LL
331				W 3 OH						2 23 16.46	61 38 57.8	RIED		LL
337	-30 21			R FOR	M	387.85	CE	GCVS		2 27 2.00	-26 19 24.0	GCVS		LL
347	50 68		45 624	UX AND	SRB	400.00	M8	DO		2 30 13.07	45 26 6.4	SAO		LL
349	60 92			CIT 4						2 31 43.00	64 56 36.0	IRC		LL
357	-30 23						M9	H&B		2 35 8.00	-27 11 24.0	IRC		LL
361										2 36 16.00	60 12 18.0	AFGL	C	LL
465	60 117	1009	64 391	DO 27024			M0	HR	2	3 20 18.58	64 24 34.1	SAO		LL
459	50 95			V384 PER	SRA	540.00	M	DO		3 22 59.00	47 21 42.0	GCVS	C	LL
500	-20 43			RT ERI	M	370.80	M7E	GCVS		3 31 54.00	-16 20 0.0	GCVS		LL
505	60 124		62 596	U CAM	SRB	400.00	N	DO		3 37 29.09	62 29 18.8	SAO	C	LL
585	40 91			V346 PER	INS?		*			4 26 57.30	35 9 56.0	SSJ	C	LL
595	60 144			DO 28489			M6	DO		4 30 49.00	62 10 12.0	IRC		LL
598	-10 70	1451	-8 887	47 ERI			M3	IRC	7	4 31 46.97	- 8 20 4.6	SAO		LL
601	20 87	1457	16 629	ALF TAU			K5	IRC	3	4 33 2.90	16 24 37.5	SAO	C	LL
618										4 39 34.00	36 1 9.0	G&H		LL
739	40 126		36 1122	GC 6640			K2	IRC		5 21 22.85	36 9 19.2	SAO		LL
746	50 145			DO 29288			M5	DO		5 23 46.00	48 40 36.0	IRC		LL
748	30 114		34 1044	S AUR	SRA	590.10	N3E	GCVS		5 23 50.00	34 6 36.0	GCVS		LL
757	0 74		-4 1146	S ORI	M	419.20	M5E	DO		5 26 32.68	- 4 43 51.7	SAO		LL
761	20 111		18 867	DV TAU	LB		M6	DO		5 28 10.41	18 31 26.5	SAO		LL
767	20 112	1845	18 875	CE TAU	SRC	165.00	M2	IRC	2	5 29 16.76	18 33 32.0	SAO		LL
767														
781										5 32 36.00	- 4 56 24.0	AFGL		LL
779	-10 93			M 42						5 32 50.00	- 5 24 42.0	IRC		LL
766	0 80			X ORI	M	422.20	M9	H&B		5 35 8.00	- 1 48 6.0	GCVS		LL
788	20 116		24 898	GP TAU	SRB	90.00	M6	DO		5 35 27.99	24 58 10.0	AGK3		LL
791	50 149			DO 29520			K5	DO		5 36 8.00	46 43 48.0	IRC		LL
794	40 135			RU AUR	M	466.47	M8E	GCVS		5 36 44.00	37 36 48.0	GCVS		LL
805	30 126			U AUR	M	408.73	M8E	GCVS		5 38 54.00	32 1 12.0	GCVS		LL
806				NGC 2023						5 39 6.00	- 2 17 0.0	AFGL		LL
807				NGC 2024						5 39 14.27	- 1 55 59.0	GLG	C	LL
937	20 145			AB GEM	LB		M3	GCVS		6 23 19.00	19 6 12.0	GCVS		LL
950	30 153			DW GEM	LB		M7	DO		6 27 53.00	27 29 24.0	GCVS		LL
955	40 156			DO 12285			K5	DO		6 29 45.00	40 44 54.0	IRC		LL
956	60 169			DO 30551			M7	DO		6 30 .30	60 58 48.0	JYCE		LL
966	40 158	2405	38 1539	UU AUR	SRB	235.00	C5	HR		6 33 6.64	38 29 16.1	SAO		LL
968	-10 131		-5 1699	GL MON	SRB	104.00	M4	H&B		6 33 21.00	- 5 20 18.0	GCVS	C	LL
971										6 34 16.50	3 28 4.0	JYCE		LL
1111	-30 87		-25 4441	VY CMA	LC		M0	IRC		7 20 54.60	-25 40 11.9	SAO		LL
1120	50 180		46 1271	Y LYN	SRC	110.00	M7	DO		7 24 33.51	46 5 35.8	SAO		LL
1135				U MON	RVB	334.07	*	GCVS		7 28 26.00	- 9 40 30.0	GCVS		LL
1135														

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
57	6.70	IRC	4.03	-.97	-1.7	-2.6			17/12/78	-1.02	-1.49	-1.51	-1.98	-2.31	-2.64	-2.83	-3.26	-2.88	JAH
59	7.39	IRC	4.28	.34	-.9	-2.9	-3.5		17/12/78	.52	-.25	-.71	-1.77	-2.19	-2.67	-2.70	-3.23		JAH
67	17.00	CK2			.6	-2.1			15/ 7/80	4.06	1.14	-.36	-1.90	-2.07	-2.43	-2.64	-2.77	-2.74	JAH
85						-1.5													
230					1.6	-1.6	-3.5		16/ 7/80	7.76	3.01	.90	-.94	-1.03	-.78	-2.22	-3.40		GG
230									30/12/80	8.29	3.48	1.42	-.37	-.67	-.46	-1.74	-2.90	-3.64	RDG
326					1.0	-3.6	-6.9												
328						-1.6	-4.6												
331						-2.0	-3.5		20/10/80			4.45	1.66	1.16	1.07	.40	-2.28	-3.49	GG
337			6.72	1.30	-.8	-2.6			19/11/78	1.90	-.20	-.75	-1.80	-1.80	-2.30	-2.00	-1.86		RDG
347	8.60	IRC	4.03		-.3	-2.1	-2.8		20/ 8/78	.02	-.31	-.12	-.64	-1.15	-1.62	-1.56	-2.57	-2.66	JAH
349			8.15	2.68	.2	-2.8	-4.4		16/ 7/80	2.27	.40	-.56	-2.20	-2.81	-3.27	-3.19	-4.20		GG
357			6.33	1.11	-.3	-2.7	-3.4		19/10/80	1.34	.41	-.04	-1.32	-1.94	-2.33	-2.09	-2.40	-2.60	GG
361						-2.0	-3.1												
465	5.22	IRC	3.14	.33	.1	-1.5			17/12/78	.27	.07	.39	.14	.15	-.02	-.10	.79		JAH
469	12.20	DO	8.57	2.18	-.9	-3.3	-3.9		17/12/78	1.61	-.29	-1.41	-2.60	-2.75	-3.23	-3.13	-3.35	-3.67	JAH
500			5.76	.11	-.4	-1.9	-2.5		19/10/80	.51	-.02	-.30	-.88	-1.26	-1.57	-1.67	-1.90	-1.80	GG
505	7.60	IRC	4.65	.38	-.6	-1.5			30/12/77	.59	-.03	.23	-.88	-1.12	-1.50	-1.39	-1.53		JAH
585	17.00	HBG	8.69	2.97	-.2	-2.9	-4.4		17/12/78	2.88	.46	-.79	-1.97	-2.05	-2.39	-2.69	-2.91	-3.15	JAH
595	12.00	DO	8.95	2.04	-.1	-1.9	-3.0		17/12/78	1.56	.09	-.82	-1.75	-1.88	-2.37	-2.25	-2.37	-2.60	JAH
598	5.11	IRC	3.19	.69	.4	-2.1			1/10/80	.62	.51	.76	.48	.50	.38	.38	.31		GG
601	.86	IRC	*	*	-3.2	-3.2				-2.86	-2.98	-2.81	-2.98	-2.97	-3.05	-3.07	-3.16	-3.16	
618						-2.5	-4.8		25/10/75	9.22	5.29	2.06	-1.52	-2.18	-2.56	-3.19	-5.05		G&H
739	6.74	IRC	5.28	2.68	1.6		-4.7		1/10/80	2.51	2.38	2.55	2.47	2.45	2.44	2.42			GG
746	10.60	DO	6.71	2.70	1.4		-4.1		17/12/78	2.63	2.36	2.32	1.67	1.72	1.11	.95	.80		JAH
748			8.22	1.97	-.1	-1.6	-4.1		21/12/77	1.61	.35	-.33	-1.26	-1.43	-1.69	-1.54	-1.40		G&H
757	7.50	IRC	4.92	-.11	-.7	-1.7			8/ 3/78	-.05	-.56	-.67	-1.26	-1.62	-1.83	-1.94	-2.52	-2.21	JAH
761	8.40	IRC	4.95	1.39	1.2	-1.7			17/ 2/78	1.34	1.11	1.30	.93	.90	.68	.55	.18	.31	RDG
767	4.35	IRC	*	-1.03	-1.2	-1.5			12/ 8/80	-.97	-1.22	-1.13	-1.29	-1.16	-1.28	-1.54	-2.41		GG
767									1/10/80	-1.05	-1.27	-.99	-1.31	-1.31	-1.50	-1.53	-1.68		GG
781					1.5	-2.4													
779			3.30	1.58	-1.1	-5.1	-7.3												
786			7.23	1.55	.4	-1.8			23/10/78	1.35	.63	.13	-.57	-.87	-1.42	-1.38			JAH
788	11.30	AGK3	4.84	.35	-.1	-1.7			17/ 2/78	.37	.03	0.00	-.45	-.89	-1.27	-1.29	-2.01	-2.27	RDG
791	11.10	DO	6.51	2.89		-1.9	-3.5		17/12/78	2.93	2.29	1.31	-.95	-1.21	-1.77	-1.88	-2.79	-3.16	JAH
794			8.32	1.39	.1	-2.0			21/12/77	.66	.14	-.11	-.81	-1.34	-1.83	-1.78	-2.26		G&H
805			4.96	.98	-.4	-1.9			21/12/77	.99	.33	-.08	-.57	-1.08	-1.35	-1.46	-1.77		G&H
806						-1.9	-3.1												
807					.4	-3.5	-6.3												
937	9.70	DO	6.68	2.55	1.5		-4.1		17/ 2/78	2.53	2.02	2.45	1.30	1.26	1.13	.99			RDG
950	10.10	DO	4.70	.42	-.2	-1.5			8/ 3/78	1.07	.31	.13	-.69	-1.32	-1.77	-1.69	-2.31	-2.43	JAH
955	12.50	DO	9.56	2.73	1.1	-1.5			17/12/78	3.76	2.35	1.48	-.17	-.55	-1.21	-1.16	-2.15	-2.23	JAH
956	11.50	DO	7.58	1.32	-.5	-2.8	-3.7		17/12/78	.78	-.28	-.85	-2.21	-2.56	-3.29	-3.08	-3.83	-4.02	JAH
966	5.29	IRC	3.04	-.71	-1.3	-2.1			17/ 2/78	-.58	-1.05	-.92	-1.62	-1.75	-2.06	-1.92	-1.94	-2.02	RDG
963			4.08	.02	-.3	-1.5	-3.7		17/12/78	.25	-.01	-.11	-.37	-.69	-.71	-.81	-1.52	-.80	JAH
971					.4	-2.2			10/11/76	5.00	2.09	.52	-1.11	-1.29	-1.57	-1.75	-1.60		JAH
1111	7.50	IRC	4.87	-.69	-3.0	-6.0	-7.7		19/10/80	-.69	-2.52	-3.56	-5.32	-5.85	-6.15	-6.13	-7.26	-6.83	GG
1120	6.90	IRC	3.16	-.48	-.8	-1.6			22/ 1/78	-.50	-.80	-.54	-.95	-1.29	-1.68	-1.46	-2.16	-2.42	JAH
1135					1.7	-1.6			19/10/80	3.70	2.81	1.76	-.40	-.86	-1.26	-1.12	-2.01	-1.93	GG
1135									30/10/80	3.89	2.92	1.93	-.23	-.55	-1.23	-.50	-1.20	-.37	RDG

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
1138	10 167		8 1800	S CHI	M	332.56	M7	DO		7 30 .29	8 25 35.5	SAO		LL
1140	-20 133			Z PUP	M	509.98	M9	H&B		7 30 29.00	-20 33 18.0	GCVS		LL
1141	30 187						M9	VOGT		7 30 44.00	30 37 18.0	IRC		LL
1151	-20 134			DU PUP	M	550.00	M	H&B		7 32 59.00	-23 52 42.0	GCVS	C	LL
1164										7 38 30.00	-23 21 0.0	AFGL		LL
1250	-10 194		-8 2343	FK HYA	LB		MB	IRC		8 22 2.25	- 8 21 27.4	SAO		LL
1261										8 28 8.00	9 18 24.0	AFGL	C	LL
1263										8 28 52.00	-22 36 30.0	AFGL	C	LL
1281	-20 173		-16 2541	AK HYA	SRB	112.00	M4	GCVS	3	8 37 35.73	-17 7 23.4	SAO	C	LL
1283										8 39 10.40	2 22 6.0	JYCE		LL
1417										10 24 21.00	5 52 54.0	AFGL	C	LL
1424										10 30 47.00	- 7 12 54.0	AFGL	C	LL
1426										10 34 31.00	- 3 47 36.0	AFGL		LL
1427	-10 242	4163	-12 3218	U HYA	SRB	450.00	C7	GCVS	3	10 35 4.97	-13 7 26.2	SAO		LL
1482	-20 227		-19 3254	T CRT	SRB	70.00	M4	IRC		11 21 23.22	-19 37 59.9	SAO	C	LL
1493										11 27 57.00	-22 21 6.0	AFGL		LL
1459	40 226		35 2265	DO 14449			M7	DO		11 32 51.00	35 8 24.0	IRC		LL
1439														
1554	0 220		5 2634	BK VIR	SRB	150.00	M7	DO		12 27 48.07	4 41 34.5	SAO	C	LL
1554														
1570	60 220		56 1615	Y UMA	SRB	168.00	M7	DO		12 38 4.42	56 7 14.8	SAO		LL
1627	-20 254	5080	-22 3601	R HYA	M	389.61	M7E	HR	7	13 26 58.48	-23 1 24.5	SAO	C	LL
1634										13 30 47.00	-26 19 30.0	AFGL	C	LL
4173	0 235		-3 3501	DO 3372			M4	DO		13 32 56.38	- 4 8 5.4	SAO		LL
4173														
1706	30 257		26 2563	RX BOO	SRB	340.00	M7	DO		14 21 56.69	25 55 48.5	SAO		LL
1715	-30 222		-29 11116	Y CEN	SRB?	180.00	M7	H&B		14 28 1.65	-29 52 34.5	SAO		LL
1767	-20 286			RS LIB	M	217.65	M7E	GCVS		15 21 26.00	-22 44 12.0	GCVS		LL
1767														
1760	80 30		79 467	S UMI	M	326.25	M8	DO		15 31 28.22	78 46 55.1	SAO		LL
1783	80 31	5826	77 592	THE UMI			K5	IRC	3	15 32 51.27	77 30 59.6	SAO		LL
1783														
1768	20 282		15 2890	TAU4 SER	LB		M7	DO		15 34 9.07	15 15 56.0	SAO		LL
4217										15 35 5.00	-15 12 36.0	AFGL	C	LL
1855										16 22 23.00	-24 17 54.0	AFGL		LL
4222										16 23 14.00	-24 29 54.0	AFGL	C	LL
1858	20 298	6119	19 3098	U HER	M	406.05	M7E	HR	7	16 23 34.86	19 0 18.0	SAO		LL
1861	-10 340	6128	-7 4292				M2?	HR	3	16 25 1.60	- 7 29 6.9	SAO		LL
1863	-30 265	6134	-26 11359	ALF SCO	SRA		M1	IRC	2	16 26 20.21	-26 19 22.0	SAO		LL
1864	40 283	6146	42 2714	30 HER			M6	HR	3	16 26 59.84	41 59 26.7	SAO		LL
1970	-10 369						M6:	H&B		17 26 33.00	- 7 25 24.0	IRC		LL
1972	-30 300						>M8	H&B		17 26 53.00	-26 25 42.0	IRC		LL
1977	20 326			DO 16032			M2	DO		17 29 42.00	17 47 36.0	IRC		LL
1988	20 328			MW HER	M	449.00	M9	WWSJ		17 33 26.00	15 36 36.0	GCVS	C	LL
1992										17 36 3.00	-30 12 46.0	JYCE		LL
1997	-30 316						M1:	H&B		17 39 22.90	-30 4 23.0	WIRO		LL
2139	-10 414						M8	H&B		18 20 28.00	-13 44 6.0	IRC		LL
2145	20 364	6895	21 3411	109 HER			K2	IRC	3	18 21 33.94	21 44 44.4	SAO		LL
2147				SHARP. 53						18 22 8.00	-13 16 6.0	AFGL		LL
4237				SHARP. 53						18 22 42.00	-13 18 0.0	AFGL		LL

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
1138	7.00	IRC	4.75	.48	2.0	-1.6			19/11/78	.56	-.05	-.16	-.71	-.94					RDG
1140			7.48	1.77	.5	-1.8			19/10/80	1.67	.77	.45	-.79	-1.38	-1.82	-1.54	-1.52	-2.00	GG
1141			7.51	2.82	.8	-1.9			2/11/78	1.70	.58	-.14	-1.43	-1.86	-2.27	-2.03	-3.56		RDG
1151			7.40	2.19	.9	-1.8			19/10/80	2.23	1.01	.60	-.54	-1.06	-1.37	-1.21	-2.10	-2.50	GG
1164							-4.8												
1250	7.50	IRC	3.63	.36	-.3	-1.8			11/ 4/78	.38	.10	-.11	-.97	-1.62	-2.19	-1.91	-2.57	-2.41	JAH
1261						-1.5													
1263						-1.8													
1281	7.04	IRC	2.80	-.57	-.7	-1.8			17/ 2/78	-.65	-.76	-.81	-1.22	-1.53	-1.84	-1.82	-2.10	-1.99	RDG
1283	15.00	JYCE			1.5	-1.5			27/ 3/78	3.31	2.35	1.91	.71	-.01	-.50	-.41	-1.07	-1.50	JAH
1417							-4.7												
1424					1.8	-1.7													
1426							-4.6												
1427	4.92	IRC	2.79	-.67	-1.4	-1.9	-2.8		21/12/77	-.40	-.64	-.57	-1.12	-.90	-1.53	-1.63			G&H
1462	8.60	IRC	4.96	1.22	.6	-1.7			4/ 4/78	1.37	1.17	.91	.94	.91	.27	.21	-.02		RDG
1493						-2.8													
1459	8.70	DO	4.38	.01	-.5	-1.6			19/ 5/79	.96	.54	-.30	-.73	-1.25	-1.37	-1.53	-1.81		JAH
1459									18/12/80	-.15	-.53	-.48	-.82	-1.13	-1.44	-1.54	-2.21	-2.45	RDG
1554	8.20	IRC	3.12	-.90	-1.4	-2.2	-2.8		1/ 6/77	-.90	-1.30	-1.61	-1.70	-1.86	-2.11	-2.19	-2.64	-2.40	BTA
1554									17/ 2/78	-.99	-1.33	-1.31	-1.64	-1.90	-2.26	-2.34	-2.62	-2.73	RDG
1570	7.90	IRC	3.84	-.53	-1.2	-2.0			20/12/77	-.53	-.87	-.88	-1.14	-1.51	-1.69	-1.84	-2.36	-2.19	G&H
1627	4.98	IRC	2.32	*	-3.2	-4.2	-4.8		27/ 3/78	-2.51	-2.92	-3.03	-3.58	-3.80	-4.09	-4.32	-4.37	-4.29	JAH
1634						-1.5													
4173	8.70	IRC	6.10	2.93	1.8	-2.1			19/ 5/79	3.02	2.77	2.83	2.72	2.65	2.71				JAH
4173									21/ 1/81	2.94	2.80	3.07	2.79	2.78	2.63	2.66	2.22		RDG
1706	6.50	IRC	2.77	-1.85	-2.3	-3.5	-4.4		17/ 2/78	-1.95	-2.36	-2.36	-2.90	-3.40	-3.74	-3.95	-4.34	-4.41	RDG
1715	7.70	IRC	3.71	-.50	-.8	-2.0	-3.4		29/ 6/80	-.68	-.80	-.64	-1.19	-1.46	-1.39	-1.50	-1.53		JAH
1767			4.92	-.28	-.9	-1.8			19/ 5/79	.09	-.43	-.70	-1.09	-.98	-1.58	-1.85	-1.78		JAH
1767									21/ 1/81	-.29	-.63	-.88	-1.23	-1.35	-1.86	-1.98	-1.53		RDG
1780	9.40	IRC	4.33	.26	-.5	-1.6	-2.7		4/ 4/78	.14	-.39	-.70	-1.13	-1.34	-1.83	-1.81	-2.13		RDG
1783	5.14	IRC	3.68	1.33	1.0		-4.3		19/ 5/79	1.21	1.11	1.27	1.22	1.10	1.07	.80	.35		JAH
1783									18/12/80	1.55	1.52	1.82	1.71	1.85	1.53	1.81	1.49		RDG
1788	6.84	IRC	2.71	-1.06	-1.4	-1.9	-2.8		12/ 6/78	-.92	-1.26	-1.13	-1.48	-1.74	-1.94	-2.02	-2.65	-2.77	RDG
4217					1.5	-1.9	-3.3												
1855						-2.0	-3.7	-6.5											
4222						-2.8	-3.2												
1858	6.70	IRC	3.87	-.31	-1.3	-2.8	-3.4		17/ 2/78	.25	-.50	-.76	-1.41	-1.77	-2.16	-2.30	-2.54	-2.59	RDG
1861	5.45	IRC	3.25	.53	.2	-2.6	-3.5		24/ 5/79	.01	-.22	.01	-.13	-.15	-.31	-.34			GG
1863	1.08	IRC	*	*	-3.6	-4.8	-4.9		24/ 5/80	-3.74	-4.01	-3.73	-4.34	-4.53	-4.58	-4.49	-4.30		GG
1864	5.01	IRC	*	*	-2.4	-2.8			26/ 5/79	-2.01	-2.22	-1.97	-2.21		-2.32				GG
1970			5.40	.24	-.6	-1.6			24/ 5/79	-.23	-.68	-.55	-1.06	-1.62	-2.13	-2.18	-2.70		GG
1972			8.20	2.34	.9	-1.5			24/ 5/80	2.60	1.53	1.24	.39	-.16	-.36	-.45			GG
1977	9.50	DO	8.20	2.64	-.7	-2.7	-3.3		26/ 5/79	2.51	.24	-.77	-1.98		-2.66				GG
1938	12.75	WUSJ	7.29	1.58	.6	-1.9	-3.0		4/ 8/78	.98	.23	-.17	-1.34	-2.01	-2.52	-2.26			RDG
1992					.3	-2.5			24/ 5/80	2.65	.70	-.10	-1.92	-2.35	-2.47	-2.61	-3.60		GG
1937			7.58	2.20	.8	-2.4	-4.1		29/ 6/80	1.82	-.31	.01	-1.12	-1.79	-2.15	-2.37	-2.72		JAH
2139			5.97	.78	-.1	-2.6	-3.7		24/ 5/79	.35	-.55	-1.05	-2.06	-2.90	-3.47	-3.61	-4.18		GG
2145	3.82	IRC	2.87	1.09	.8	-1.6			26/ 5/79	1.10	1.03	1.19	1.11		1.24				GG
2147						-2.3	-4.0												
4237					1.6	-1.6													

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
2151	-20 482			V2548 SGR	?		C	H&B		18 23 28.70	-22 6 11.0	WIRO		LL
2152										18 23 39.00	-11 51 18.0	AFGL		LL
2154										18 23 57.60	- 6 55 55.0	JYCE		LL
2154														
2154														
2154														
2155				DO 16793						18 24 .80	23 27 1.0	JYCE		LL
2155														
2155														
2155														
2157				W 39						18 24 22.00	-12 42 0.0	AFGL		LL
2162	-10 422		-12 5055	UY SCT	LC		M4	GCVS	2	18 24 49.00	-12 30 0.0	GCVS	C	LL
2165				SHARP. 62						18 25 1.20	- 3 51 45.0	WIRO	C	LL
2169										18 26 30.00	-10 55 12.0	AFGL		LL
2177				W 40						18 28 47.87	- 2 7 35.3	WIRO	C	LL
2178										18 28 52.40	- 8 37 27.0	JYCE		LL
2178														
2190										18 31 26.00	- 7 20 54.0	AFGL	C	LL
2200										18 33 30.00	- 7 11 48.0	AFGL		LL
2205										18 34 52.30	- 5 26 36.0	WIRO		LL
2206	10 365			V1111 OPH	M		M9	VOGT		18 34 59.00	10 23 0.0	IRC		LL
2210										18 35 33.70	- 6 50 33.0	WIRO	C	LL
2213	10 366	7002	8 3780	X OPH	M	334.39	• M6E	HR	3	18 35 57.51	8 47 19.7	SAO	C	LL
2222										18 37 20.90	- 0 21 27.0	JYCE		LL
2223	-10 450						M:	H&B		18 37 35.00	- 5 45 48.0	IRC	C	LL
2227	0 363			DO 5003			<MO	H&B		18 38 48.00	- 4 23 30.0	IRC	C	LL
2232	20 370						C2	CK2		18 39 41.00	17 37 36.0	IRC		LL
2233	0 365									18 39 51.00	- 2 21 12.0	IRC	C	LL
2376				HFE 59						19 20 9.00	13 58 30.0	AFGL	C	LL
2378										19 20 38.00	14 23 0.0	AFGL	C	LL
2379										19 20 44.00	14 10 0.0	AFGL	C	LL
2381				W 51						19 21 24.00	14 24 40.0	HGG	C	LL
2383	50 294		49 2999	CH CYG	SRA	97.00	M3	IRC		19 23 14.18	50 8 31.0	SAO		LL
2383														
2393	10 420			DO 5752			R	• DO		19 24 26.00	11 15 12.0	IRC		LL
2398	0 437	7412	2 3904	SVS 101849			K5	DO		19 27 39.77	2 47 55.8	SAO		LL
2402	0 439	7414	-3 4612	36 AQL			M1	HR	3	19 28 2.91	- 2 53 40.3	SAO		LL
2409	40 348			UV CYG	SRB	135.50	M6	GCVS		19 29 38.00	43 31 30.0	GCVS		LL
4250				V1137 AQL	SR?					19 30 37.00	13 38 6.0	GCVS		LL
2414	20 413			EP VUL	INA		C	GCVS		19 31 11.00	23 32 30.0	GCVS	C	LL
2417	30 374						C	VOGT		19 32 12.00	27 57 0.0	IRC		LL
2425										19 36 8.70	-16 58 50.0	G&H		LL
2425														
2425														
2433										19 38 58.00	39 56 12.0	AFGL	C	LL
2565	40 411	7796	39 4159	GAM CYG			F8	IRC	2	20 20 25.93	40 5 44.6	SAO	C	LL
4265										20 22 41.00	- 7 19 18.0	AFGL	C	LL
2575	40 415			KY CYG	LB		N	DO		20 24 6.00	38 11 0.0	GCVS		LL
2578										20 25 17.00	39 15 30.0	AFGL	C	LL
2584				SHARP. 106						20 25 32.81	37 12 49.9	WIRO	C	LL

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
2151			7.35	2.43	.6	-1.5			29/ 6/80	2.02	1.06	.78	-.37	-.71	-.87	-1.14	-1.06		JAH
2152						-1.5													
2154					.6	-1.9	-2.8		23/ 6/78	5.21	1.66	.09	-1.61	-1.83	-2.14	-2.12			RDG
2154									26/ 7/79					-2.23					RDG
2154									17/ 4/80	4.56	1.71	.17	-1.67	-1.89	-2.08	-2.31	-2.37		RDG
2154									18/ 4/80	4.55	1.60	-.01	-1.65	-1.87	-2.31	-2.38	-2.63		RDG
2155					1.2	-2.7	-3.6		23/ 6/78	5.79	1.66	-.31	-2.52	-2.88	-3.21	-3.24	-3.85		RDG
2155									26/ 7/79					-2.60					RDG
2155									17/ 4/80	5.68	1.79	-.29	-2.44	-2.71	-3.10	-3.32	-3.55		RDG
2155									18/ 4/80	5.79	1.86	-.20	-2.43	-2.75	-3.19	-3.40	-3.78		RDG
2157						-1.5	-3.3												
2162			5.50	.96	-.1	-2.2	-3.3		24/ 5/79	.41	-.24	-.40	-1.35	-2.23	-2.82	-2.85	-3.35		GG
2165					.8	-2.1	-3.2		24/ 5/80	3.01	1.37	.31	-1.00	-1.24	-1.45	-1.74	-2.56		GG
2169						-2.3	-3.9												
2177					1.6	-2.9	-5.5												
2178					.6	-2.3			23/ 6/78	5.09	1.50	-.05	-1.77	-2.04	-2.34	-2.39	-2.39		RDG
2178									18/ 4/80	4.99	1.53	-.12	-1.81	-2.02	-2.39	-2.51	-2.73		RDG
2190						-2.1	-4.6												
2200							-4.2												
2205						-1.5	-3.9		15/ 7/80	9.87	2.51	-.02	-1.70	-1.72	-1.60	-3.14	-3.68	-4.00	JAH
2206			6.85	.77	-.4	-3.4	-4.3	-6.7	24/ 5/80	.86	-.45	-1.17	-2.47	-3.00	-3.48	-3.21	-4.38		GG
2210						-2.9	-6.1												
2213	6.40	IRC	4.06	-.90	-1.3	-2.3	-2.9	-6.3	24/ 3/80	-.78	-1.31	-1.53	-2.06	-2.31	-2.53	-2.65	-3.02	-2.87	GG
2222						-1.7			24/ 5/80	3.06	1.52	.65	-.78	-1.18	-1.58	-1.64	-2.69		GG
2223			9.33	2.94	.8	-1.7	-3.3		24/ 3/80	3.62	2.14	1.31	-.33	-.80	-1.19	-1.18	-2.19	-2.19	GG
2227	11.50	DO	7.00	2.06	.7	-2.4	-3.7		24/ 5/80	2.09	.99	.21	-1.24	-2.05	-2.57	-2.43	-3.70		GG
2232	12.90	CK2	6.78	1.87	-1.7	-3.5	-3.8		24/ 5/80	1.93	.05	-1.20	-2.47	-2.69	-3.06	-3.09	-3.46		GG
2233			7.98	2.67	-.9	-3.5	-3.6		24/ 5/80	3.37	.58	-.59	-2.22	-2.46	-2.72	-2.79	-3.15		GG
2376					1.3	-2.5	-5.7	-7.8											
2378						-1.7	-4.5												
2379						-2.1	-4.6	-6.5											
2381					1.7	-3.6	-6.9	-8.8											
2383	7.07	IRC	2.98	-.68	-1.4	-2.9	-3.5		7/ 6/80	-.69	-1.26	-1.58	-2.28	-2.51	-2.85	-2.57	-2.70		GG
2383									30/10/80	-.95	-1.47	-1.78	-2.28	-2.63	-2.95	-2.76	-3.15	-2.88	FDG
2390	11.70	DO	8.03	2.75	.1	-4.2	-6.2	-6.7	7/ 6/80	2.96	.84	-.60	-2.88	-3.80	-4.40	-4.39	-5.70		GG
2398	6.22	IRC	4.31	1.44	1.1	-1.6	-3.5		24/ 5/80	1.55	1.33	1.58	1.39	1.36	1.33				GG
2402	5.22	IRC	3.19	.62	.5	-3.2			24/ 5/80	.55	.36	.59	.47	.46	.34	.40			GG
2409	8.90	DO	5.20	.82	.4	-1.7	-3.6	-6.6	7/ 6/80	.82	.54	.63	-.01	-.67	-1.27	-1.19	-1.60		GG
4250						-1.8	-2.7												
2414	10.70	DO	5.58	.95	.5	-1.5			7/ 6/80	1.02	.65	1.04	.64	.44	.16	.06	-.10		GG
2417			7.81	2.89	-.4	-2.8	-3.4		7/ 6/80	2.67	.40	-.65	-2.12	-2.30	-2.66	-2.61	-2.70		GG
2425					1.6	-1.6	-3.0		12/ 6/78	2.88	1.96	1.34	-.26	-.87	-1.44	-1.17	-2.05		RDG
2425									30/ 8/79	2.48	1.71	1.13		-.86	-1.49				RDG
2425									18/ 4/80	2.98	2.09	1.67	.50	-.06	-.57	-.38	-1.33		[illegible]
[illegible]					1.7	-2.1	-2.2												
2565	2.23	IRC	*	.70	.3	-1.6	-4.0	-6.5	7/ 6/80	.75	.64	.59	.60	.59	.56	.56			GG
4265							-4.0												
2575	10.50	DO	6.00	.28	-.4	-2.6	-3.9		17/ 8/78	.10	-.58	-.61	-1.66	-2.67	-3.23	-3.24	-3.88		RDG
2578						-1.7	-4.1	-6.1											
2584					1.6	-2.5	-5.9	-7.3											

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
2586										20 26 29.00	40 42 30.0	AFGL	C	LL
2590	40 424			RW CYG	SRC	586.00	M6	DO	2	20 27 1.00	39 48 36.0	GCVS		LL
2591										20 27 35.90	40 1 5.0	LKVR		LL
2591														
2593				W 69						20 27 42.00	38 50 18.0	AFGL		LL
2602										20 30 46.40	40 5 48.0	KLMN		LL
2603				MWC 349						20 30 56.86	40 29 20.4	BHR		LL
2605	40 431									20 31 7.00	40 35 6.0	IRC		LL
2609	40 434			DO 38592			K5	DO		20 32 14.00	42 15 12.0	IRC		LL
2618	20 474	7886	17 4370	EU DEL	SRB	59.50	M6	MR	7	20 35 37.75	18 5 30.3	SAO		LL
2618														
2621				W 75 N						20 36 51.34	42 27 19.0	WIRO		LL
2624				DR 21						20 37 13.64	42 9 6.0	WIRO	C	LL
2625				DR 22						20 37 28.00	41 8 6.0	AFGL		LL
2632	50 338		47 3167	V CYG	M	421.43	M1	DO		20 39 41.32	47 57 45.4	SAO		LL
2757	80 45			GH CEP	M	331.00	K5	DO		21 20 36.00	77 37 42.0	GCVS		LL
2775	10 498			UU PEG	M	456.50	M7E	GCVS		21 28 39.00	10 55 54.0	GCVS		LL
2781	40 485			V1426 CYG	M	470.00	M	DO		21 32 5.00	38 51 0.0	IRC	C	LL
2785	80 46		77 827	S CEP	M	486.99	M8E	IRC		21 35 52.65	78 23 58.7	SAO		LL
2787	0 507		-2 5597	DO 7540			M5	IRC		21 37 44.76	- 2 0 48.0	SAO		LL
2790	50 390		53 2684	RU CYG	SRA	233.85	M8E	IRC		21 38 58.51	54 5 49.3	SAO		LL
2900	30 492			RV PEG	M	389.97	M6E	GCVS		22 23 19.00	30 13 0.0	GCVS		LL
2901										22 24 8.10	68 5 25.0	G&H		LL
2922	60 361			DO 41575			M2	DO		22 31 43.00	58 38 6.0	IRC		LL
2925	60 362		57 2568	U CEP	SRC		R	IRC		22 34 32.71	58 9 59.9	SAO	C	LL
2929	80 55	8625	74 978	DO 41729			M4	DO	7	22 36 8.77	75 6 41.6	SAO		LL
3099							C	GHB		23 25 45.00	10 38 8.0	JYCE	C	LL
3099														
3099														
3099														
3099														
3099														
3099														
3099														
3099														
3099														
3099														
3099														
3099														
3109	60 409			DO 43188			M4	DO		23 27 53.30	60 0 15.0	WIRO		LL
3110	60 410			V358 CAS	LB		M7	DO		23 28 0.00	57 42 42.0	GCVS		LL
4299	60 411			SVS 5744			M4	DO		23 28 25.50	59 58 48.0	WIRO		LL
3112	50 468		45 4259	DO 43251			M4	DO		23 30 31.06	45 50 50.2	SAO		LL
3116	40 540						C	LWD		23 32 1.00	43 16 30.0	IRC		LL
3116														
3119										23 32 33.00	2 49 54.0	AFGL	C	LL
3125	50 474		51 3676	SV CAS	SRA	276.30	M8	DO		23 36 35.98	51 59 7.6	SAO		LL
3125														

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
2586						-1.9	-4.4												
2590	11.00	DO	4.86	.55	-.1	-2.4	-3.6	-6.2	7/ 6/80	.58	.07	.02	-.91	-1.97	-2.64	-2.42	-3.40		GG
2591					.5	-2.6	-4.7	-6.7	7/ 6/80	5.73	1.59	-.45	-1.71	-2.24	-2.23	-3.40	-4.40		GG
2591									1/10/80	5.74	1.63	-.32	-1.78	-2.14	-2.25	-3.31	-4.43		GG
2593						-1.4	-4.2												
2602						-2.4	-4.9	-7.3											
2603					1.5	-2.0	-4.0		7/ 6/80	3.40	1.43	.28	-1.23	-1.53	-1.72	-1.96	-2.60		GG
2605			7.55	1.14	.3	-1.6			25/ 6/78	1.16	.43	.38	-.85	-1.38	-1.83	-1.82			GG
2609	10.10	DO	8.43	1.14	.3	-2.0	-2.7		25/ 6/78	1.16	.38	.30	-.67	-1.40	-1.90	-1.76			GG
2618	6.27	IRC	2.34	-1.10	-1.4	-1.8			1/ 6/77	-1.03	-1.32	-1.14	-1.44	-1.47	-1.61	-1.58	-2.00		ETA
2618									17/ 8/78	-1.08	-1.43	-1.23	-1.50	-1.63	-1.67	-1.81			RDG
2621						-1.1	-4.2												
2624						-1.0	-4.6												
2625						-1.4	-4.6												
2632	6.80	IRC	7.09	.82	-1.9	-3.5	-3.6		7/ 6/80	-.01	-1.54	-2.56	-3.26	-3.47	-3.84	-3.71	-3.94		GG
2757	11.50	DO	8.35	2.37	1.0	-.8	-4.0		8/ 6/80	2.59	1.60	1.16	.30	-.28	-.57	-.52	-1.31		GG
2775	10.00	DO	7.05	1.53	0.0	-2.3	-3.3		8/ 6/80	1.10	.37	.16	-.83	-1.59	-2.03	-1.80	-2.66		GG
2781	13.00	LWD	8.71	2.04	-.2	-2.0			8/ 6/80	1.22	-.35	-1.17	-2.09	-2.43	-2.76	-2.64	-2.71		GG
2785	7.00	IRC	5.25	-.15	-1.6	-2.9	-3.4		8/ 6/80	-.24	-1.25	-1.44	-2.32	-2.64	-2.90	-2.65	-3.01		GG
2787	9.30	IRC	4.68	.76	.4	-2.1			8/ 6/80	.90	.53	.58	.15	-.03	-.46	-.53	-1.20		GG
2793	6.90	IRC	3.96	-.30	-.8	-2.2	-3.3		8/ 6/80	.26	.11	-.01	-.78	-1.54	-1.90	-1.68	-1.69		GG
2900			7.46	2.12	1.3	-1.7			8/ 6/80	1.72	.98	.54	-.79	-1.53	-1.99	-1.67	-2.42		GG
2901					.8	-2.0	-3.0		25/10/75	3.83	1.04	-.36	-1.97	-2.18	-2.46	-2.69	-3.24	-3.44	G&H
2922	10.50	DO	7.21	2.01	.7	-1.7	-4.0		8/ 6/80	1.97	1.39	1.34	.49	-.52	-1.06	-.86	-1.71		GG
2925	6.90	IRC	5.43	2.56	1.2	-1.5			26/ 6/78	2.56	1.66	1.15	-.51	-1.13	-1.61	-1.31			GG
2929	5.90	IRC	4.33	1.83	1.6	-1.9			8/ 6/80	1.86	1.68	1.90	1.82	1.67	1.74				GG
3099					1.1	-2.0	-3.8		12/ 6/78	5.92	2.19	.22	-1.83	-2.13	-2.56	-2.67	-2.95		RDG
3099									18/ 6/78	5.66	1.96	-.11	-2.11	-2.42	-2.71	-2.90	-3.33	-3.56	JAH
3099									23/ 6/78	5.89	2.12	.19	-1.83	-2.18	-2.50	-2.61	-3.20		RDG
3099									25/ 7/78	5.86	2.10	.20	-1.75	-2.06	-2.53				GG
3099									4/ 8/78	5.92	2.04	.10	-1.81	-2.22	-2.56	-2.68	-3.17		RDG
3099									16/ 8/78	6.47	2.50	.52	-1.62	-2.11	-2.41	-2.64	-3.39		RDG
3099									20/10/78	6.59	2.54	.49	-1.68	-1.98	-2.42	-2.46	-3.05	-3.17	RDG
3099									26/ 7/79					-2.06					RDG
3099									27/ 7/79	6.50	2.63	.60	-1.57	-1.97	-2.26	-2.42	-2.80	-3.22	RDG
3099									30/ 8/79	7.08	2.47	.38	-1.68	-2.10	-2.42	-2.57	-3.15		RDG
3099									4/10/79	5.71	2.03	.10	-1.95	-2.22	-2.57	-2.74	-3.15	-3.45	RDG
3099									17/ 4/80	7.27	3.31	1.05	-1.10	-1.48	-1.83	-1.89	-2.19		RDG
3099									5/ 8/80	7.65	3.65	1.66	-.85	-1.28	-1.64	-1.85	-2.46	-2.75	RDG
3109	11.30	DO	7.36	2.68	.5	-1.8	-3.9		29/ 6/80	1.84	1.23	1.11	-.04	-.90	-1.48	-1.30	-2.15		JAH
3110	11.80	DO	6.22	2.10	1.3	-1.5			17/ 8/78	2.09	1.50	1.55	.36	-.65	-1.13	-1.05	-1.93		RDG
4299	11.30	DO	6.72	2.04	.9	-1.6			29/ 6/80	1.74	1.17	1.03	-.04	-1.04	-1.60	-1.45	-2.58		JAH
3112	6.86	IRC	4.65	1.77	1.4	-1.0	-4.5		29/ 6/80	1.86	1.70	1.92	1.73	1.59	1.77	1.37	1.03		JAH
3116			9.21	2.48	-.3	-3.5	-4.6		18/ 6/78	2.81	.02	-1.64	-3.32	-3.60	-3.98	-4.02	-4.71	-5.24	JAH
3116									3/11/78	2.51	-.27	-1.78	-3.27	-3.44					RDG
3119							-4.4												
3125	6.70	IRC	3.86	.17	-.5	-1.7	-3.4		18/ 6/78	-.18	-.51	-.59	-1.04	-1.67	-2.23	-1.97	-3.05	-3.30	JAH
3125									17/ 8/78	.32	-.02	-.15	-.58	-1.29	-1.76	-1.54	-2.32		RDG

TABLE 3

WIRO CATALOG OF AFGL SOURCES

LOST SOURCE SUBCATALOG

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
62										0 22 26.00	47 23 0.0	AFGL		LST
4003										0 25 35.00	31 19 48.0	AFGL		LST
4004										0 31 3.00	- 7 56 0.0	AFGL		LST
90	50 11			DO 23568			K5	DO		0 34 34.00	53 25 30.0	IRC		LST
92	60 15			FZ CAS	LB		M8	VOGT		0 36 17.00	59 24 0.0	IRC		LST
96	40 12			DO 8439			M6	DO		0 36 53.00	37 56 36.0	IRC		LST
99	60 16		58 89				M	DO		0 37 31.91	59 14 22.8	SAO		LST
104	40 13			NGC 224						0 39 59.00	41 0 30.0	AFGL		LST
214										1 24 26.00	16 40 30.0	AFGL		LST
216	20 25			ST PSC	LB		M5	GCVS		1 25 10.00	16 26 18.0	GCVS		LST
220	50 36		50 282	DO 24371			M6	DO		1 25 33.37	51 25 14.9	SAO		LST
225										1 27 44.00	15 25 0.0	AFGL		LST
236	10 19		7 240	SVS 100126			M0	IRC		1 34 6.09	7 34 36.4	SAO		LST
240	70 30		64 208	DO 24571			M7	DO		1 35 27.74	65 15 44.8	SAO		LST
245										1 39 57.00	28 18 0.0	AFGL		LST
4021										2 22 6.00	38 34 48.0	AFGL		LST
333				W 4						2 24 13.00	61 18 6.0	AFGL		LST
339	-20 33	735	-23 947	GC 3015			M1	IRC	7	2 28 15.95	-22 45 58.7	SAO		LST
341										2 29 19.20	57 49 27.0	LKRL		LST
341														
348	-10 35		-13 479	U CET	M	234.67	M3E	IRC		2 31 19.62	-13 22 2.5	SAO		LST
4023										2 32 11.00	21 38 54.0	AFGL		LST
360				RR CEP	M	383.49	M6E	GCVS		2 36 8.00	80 55 42.0	GCVS		LST
363										2 36 40.00	6 8 18.0	AFGL		LST
4025										2 37 5.00	- 6 28 6.0	AFGL		LST
369										2 39 55.00	- 5 46 36.0	AFGL		LST
488	-10 47		-12 649	VX ERI	SR?		M3	IRC		3 22 47.07	-12 31 48.5	SAO		LST
490										3 23 38.80	58 36 39.0	JYCE		LST
4033										3 27 50.00	-19 24 18.0	AFGL		LST
4034										3 31 30.00	-12 57 48.0	AFGL		LST
4035										3 33 16.00	-18 52 18.0	AFGL		LST
574										4 20 42.00	-13 0 18.0	AFGL		LST
4048										4 25 41.00	-23 10 54.0	AFGL		LST
589										4 29 4.00	22 45 12.0	AFGL		LST
593	-10 71	1452	-9 930	GC 5577			K4	IRC	3	4 31 47.98	- 9 4 18.9	SAO		LST
603	-30 37	1464	-30 1901	UPS2 ERI			K0	IRC	3	4 33 36.32	-30 39 49.0	SAO		LST
604	-10 72						M7	H&B		4 33 47.00	- 5 22 0.0	IRC		LST
4051	0 71			V535 ORI	LB		M4	H&B		5 20 53.00	- 4 37 12.0	GCVS		LST
4052										5 21 26.00	-20 35 18.0	AFGL		LST
744										5 23 36.00	- 0 40 48.0	AFGL		LST
768	70 63			DO 29388			M6	DO		5 29 29.00	65 1 24.0	IRC		LST
776										5 31 57.00	- 5 14 48.0	AFGL		LST
778										5 32 26.00	67 25 24.0	AFGL		LST
795										5 37 11.00	-12 28 36.0	AFGL		LST
928	0 106						M8	LWD	7	6 21 41.00	- 0 4 0.0	IRC		LST
4060	0 105						M7	VOGT		6 21 30.00	- 0 15 36.0	IRC		LST
938										6 23 32.00	68 57 24.0	AFGL		LST
940										6 23 59.00	9 2 54.0	AFGL		LST
941				BY MON	SRB	85.00	M6	GCVS		6 24 12.00	3 42 0.0	GCVS		LST
943	10 124			SW MON	SRB	112.00	M5	DO	3	6 24 22.00	5 24 24.0	GCVS		LST

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
62					1.8														
4003					1.6														
4004							-3.2												
90	10.60	DO	6.99	2.80	1.7														
92	10.50	LWD	6.08	1.81	1.4	-.6													
96	9.20	DO	5.95	2.33	1.6														
99	7.17	IRC	4.80	1.92	1.7	-1.1													
104			5.20	2.82	1.8														
214					1.7														
216			5.84	1.75	1.5				1/11/78	1.63	1.32	1.28	.76	.12	-.30	-.05	-1.20	-1.53	RDG
220	8.70	IRC	6.01	2.76			-3.1		17/12/78	2.58	2.43	2.56	2.38	2.21	1.89	2.28			JAH
225					1.8														
236	6.68	IRC	4.39	1.53	1.4														
240	8.80	IRC	5.51	1.93	1.4	-.6													
245					1.6														
4021							-3.0												
333						-1.1													
339	6.10	IRC	4.62	2.13	1.4		-2.9												
341						-1.2			25/10/75	9.96	5.29	2.40	-.36	-.72	-1.10	-1.48	-2.18	-2.47	G&H
341									2/11/78	8.10	5.11	2.33	-.48	-.87	-1.16	-1.42	-2.74		RDG
346	6.60	IRC	6.71	2.95	1.7														
4023					1.5														
360					1.6		-2.0												
363							-3.7												
4025					1.4														
369					1.9														
468	8.70	IRC	6.26	2.91	1.6														
490						-.6	-3.1		10/11/76	5.41	2.93	1.81	0.00	-.47	-.61	-1.48	-2.58		JAH
4033						-1.3	-2.9												
4034					1.6														
4035					1.6														
574					1.6	-1.4													
4048					1.8														
589							-3.9												
593	5.27	IRC	3.98	1.71	1.5														
603	3.81	IRC	3.11	1.73	1.4														
604			5.87	2.09	1.6				1/11/78	1.95	1.77	1.66	1.40	1.29	1.18	.89	1.06		RDG
4051	9.60	DO	6.10	2.27	1.6														
4052					1.6														
744					1.5														
768	10.30	DO	6.16	2.28	1.4														
776						-1.3													
778					1.4														
795					1.7														
928	11.70	LWD	7.13	2.09	1.5				2/11/78	1.90	1.51	1.47	.78	0.00	-.55	-.35	-1.83		RDG
4060			6.57	2.45	1.4				2/11/78	2.44	2.12	2.13	1.78	1.43	1.14	1.11			RDG
938					1.8	-.8													
940					1.4	-1.1													
941					1.4														
943	9.80	DO,	6.71	2.93	1.6				28/12/78	2.89	2.66	2.66	2.40	2.21	1.93		1.41		RDG

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC.	SOURCE	COMMENT	CLASS
944										6 24 34.00	-19 35 18.0	AFGL		LST
4061										6 26 2.00	44 47 0.0	AFGL		LST
949	10 125			DO 1612			M5	DO		6 27 41.00	8 6 30.0	IRC		LST
4063										6 29 5.00	45 56 30.0	AFGL		LST
957	60 170	2376	55 1093	7 LYN			K0	IRC		6 30 23.29	55 23 32.1	SAO		LST
961										6 31 54.00	4 16 36.0	AFGL		LST
965										6 32 19.00	-12 26 24.0	AFGL		LST
969										6 33 57.00	17 46 18.0	AFGL		LST
975	20 154	2421	16 1223	GAM GEM			A0	IRC	4	6 34 49.40	16 26 37.4	SAO		LST
976	10 129		14 1365	UU GEM	M	433.00	K0	IRC		6 34 47.54	14 43 44.5	SAO		LST
981	10 130		5 1345	DO 1689			M5	DO		6 36 11.17	5 14 11.1	SAO		LST
986	0 122			DO 1697			M7	H&B		6 36 57.00	- 2 24 24.0	IRC		LST
989										6 38 25.30	9 32 29.0	JYCE		LST
990										6 38 48.00	2 48 30.0	AFGL		LST
996										6 39 38.00	1 24 6.0	AFGL		LST
1115										7 22 52.00	6 10 42.0	AFGL		LST
1130	30 186	2861	28 1400	65 GEM			K2	IRC	3	7 26 42.25	28 1 15.8	SAO		LST
1139	10 168		11 1607	DO 2247			M5	DO		7 30 41.74	11 7 14.7	SAO		LST
1143	70 78		66 512	DO 31652			M6	DO		7 31 9.62	66 34 51.3	SAO		LST
4074	40 181		38 1798	DO 13184			M3	IRC		7 34 45.45	38 22 21.9	SAO		LST
1159										7 36 42.00	- 8 21 6.0	AFGL		LST
4084										8 25 41.00	72 33 12.0	AFGL		LST
1258	-10 196		-5 2550	RT HYA	SRB	253.00	MC	IRC		8 27 13.21	- 6 9 .6	SAO		LST
1260										8 27 44.00	-21 17 36.0	AFGL		LST
1273										8 34 40.00	- 8 39 24.0	AFGL		LST
1275										8 36 1.00	11 11 36.0	AFGL		LST
4087										8 36 26.00	46 9 42.0	AFGL		LST
1282	0 177			DO 2576			M6	H&B		8 38 25.00	- 0 30 36.0	IRC	C	LST
1350	60 194	3722	64 733	GC 12970			K2	IRC		9 21 44.00	64 9 26.8	SAO		LST
1352										9 23 40.00	21 0 24.0	AFGL		LST
1355	40 206		45 1728	DO 32882			M6	DO		9 27 42.27	44 54 15.5	SAO		LST
4094										9 28 21.00	44 56 6.0	AFGL		LST
1360	70 90	3771	70 565	24 UMA			G2	IRC	4	9 30 5.84	70 3 6.5	SAO		LST
4056	70 91	3824	67 602	DO 32923			K5	IRC		9 35 21.05	67 29 56.0	SAO		LST
1481										11 20 29.00	24 24 18.0	AFGL		LST
4131	50 210		49 2050	DO 33683			M2	DO		11 21 48.50	48 52 50.4	SAO		LST
1484										11 22 27.00	16 29 48.0	AFGL		LST
1487				IC 2811						11 23 20.00	9 30 30.0	AFGL		LST
1498										11 32 28.00	19 27 12.0	AFGL		LST
1500	80 24		78 392	DO 33752			M2	DO		11 34 36.65	77 52 21.4	SAO		LST
4153										12 32 3.00	8 27 36.0	AFGL		LST
4155										12 32 49.00	8 22 42.0	AFGL		LST
4156										12 32 51.00	6 18 36.0	AFGL		LST
1571	0 223	4825	-0 2601	GAM VIR			F0	IRC	5	12 39 7.46	- 1 10 31.9	GC		LST
1620	40 245	5052	37 2404	DO 14749			M4	IRC	7	13 21 38.03	37 17 39.9	SAO		LST
1625										13 26 12.00	55 24 12.0	AFGL		LST
4214										15 20 56.00	16 32 12.0	AFGL		LST
4215										15 26 16.00	17 34 0.0	AFGL		LST
1763										15 34 4.00	21 48 12.0	AFGL		LST
1652	30 287	6103	31 2845	XI CRB			K0	IRC	3	16 20 8.82	31 0 25.0	SAO		LST

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
944							-3.3												
4061							-3.3												
949	11.20	DO	6.76	2.73	1.4														
4053							-3.4												
957	6.38	IRC	5.24	2.52	1.4														
961						-.4	-3.3												
965					1.6														
969						-1.4													
975	1.93	IRC	*	1.88	1.5	0.0													
976	8.60	IRC	7.68	3.03	1.5														
981	8.30	IRC	4.94	1.86	1.4														
986	11.00	DO	6.91	2.64	1.8														
989					1.4	-1.1	-3.3												
990					1.5														
996					1.5														
1115					1.6														
1130	5.01	IRC	4.32	2.59	1.4														
1139	7.50	IRC	4.63	1.81	1.5														
1143	7.40	IRC	5.07	2.01	1.5														
4074	7.60	IRC	5.25	2.26	1.5														
1159							-3.9												
4084						-.5	-2.8												
1258	8.40	IRC	3.69	-.17		-1.3			11/ 4/78	.09	.28	-.37	-.78	-.85	-1.02	-1.13	-1.34	-.85	JAH
1260					1.5														
1273					1.5														
1275					1.4														
4027					1.4														
1282	11.20	DO	6.46	2.13	1.5														
1350	6.31	IRC	4.97	2.70	1.6														
1352						-1.0													
1355	8.10	IRC	5.10	1.95	1.6				11/ 4/78	2.04	1.82	1.93	1.21	.80	.37	.50	-1.01	-1.17	JAH
4094						-.8													
1360	4.58	IRC	4.03	2.72	1.7														
4096	6.13	IRC	4.59	2.34	2.3														
1481						-1.1	-2.7												
4131	7.10	IRC	5.37	2.84	1.5														
1484					1.4														
1487						-.3	-3.8												
1498					1.7														
1500	6.71	IRC	5.11	2.45	1.7														
4153							-2.6												
4155							-3.2												
4156						-.5													
1571	3.65	IRC	2.50	1.88	1.6														
1620	6.17	IRC	4.18	1.31	1.4														
1625					1.7	-1.0													
4214							-3.2												
4215							-3.1												
1789					1.8														
1852	4.85	IRC	4.20	2.59	1.6				12/ 6/78	2.65	2.57	2.65	2.59	2.57	2.66				RDG

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUM	R.A. 1950.00	DEC. 1950.00	SOURCE	COMMENT	CLASS
1857										16 23 28.00	- 1 19 24.0	AFGL		LST
4224										16 23 44.00	-24 17 48.0	AFGL		LST
4226										16 30 11.00	- 2 20 12.0	AFGL		LST
4227										16 32 48.00	- 8 19 42.0	AFGL		LST
1960	0 302		1 3425	DO 4277			M5	DO		17 20 22.49	0 55 9.9	SAO		LST
1963										17 22 0.00	-24 38 12.0	AFGL		LST
4231										17 28 14.00	4 49 54.0	AFGL		LST
1981	0 305		0 3717	DO 4306			M4	DO		17 30 43.37	0 8 14.0	SAO		LST
1985										17 33 22.00	17 39 54.0	AFGL		LST
4232										17 33 46.00	36 0 12.0	AFGL		LST
1991	-20 374			SVS 3315			M7	LWD	7	17 35 13.00	-20 50 24.0	IRC		LST
2143										18 21 33.00	-16 15 24.0	AFGL		LST
2153										18 23 52.00	-12 26 48.0	AFGL		LST
2160										18 24 39.00	10 50 36.0	AFGL		LST
2161										18 24 29.30	-12 1 36.0	JYCE		LST
2171							M8	CK2		18 27 34.40	82 36 52.0	JYCE		LST
2172										18 27 32.00	24 19 42.0	AFGL		LST
2174				SHARP. 56						18 28 26.40	- 9 46 54.0	JYCE		LST
2174														
2174														
4238		7394	88 112	LAM UMI			M1	HR	3	18 21 21.82	89 3 3.5	SAO		LST
2184				GC 25364			MA	GC		18 31 48.30	86 37 43.2	GC		LST
2185	-10 434						M7:	H&B		18 30 30.00	- 7 29 0.0	IRC		LST
2188										18 30 53.00	- 9 10 42.0	AFGL		LST
2191										18 31 32.00	-21 3 30.0	AFGL		LST
2193				W 41						18 31 46.00	- 8 45 42.0	AFGL		LST
2194										18 31 49.00	- 7 59 18.0	AFGL		LST
2195										18 32 2.00	- 8 36 6.0	AFGL		LST
2199										18 33 19.60	5 33 17.0	JYCE		LST
2199														
2199														
2202										18 33 51.00	- 7 23 24.0	AFGL		LST
2207										18 35 4.00	- 6 22 18.0	AFGL		LST
2211										18 35 39.00	- 5 32 30.0	AFGL		LST
2214	-10 446		-13 5060				K5	IRC		18 36 3.15	-13 49 20.0	SAO		LST
2220	-10 449	7007	-7 4648	GC 25524			K4	IRC	7	18 37 17.69	- 7 50 13.1	SAO		LST
2228	30 339			SY LYR	LB		M6	GCVS		18 39 31.00	28 45 42.0	GCVS		LST
2229	-10 454						M2	H&B		18 39 26.00	- 5 4 42.0	IRC		LST
2380										19 20 55.00	14 47 42.0	AFGL		LST
2388	70 156			YZ DRA	M	347.60	M8E	GCVS		19 24 19.00	71 35 6.0	GCVS		LST
2389	40 347		35 3614	DO 17754			M6	DO		19 24 10.00	36 5 8.4	SAO		LST
4249				SHARP. 82						19 28 5.00	18 11 36.0	AFGL		LST
2403										19 28 18.00	19 44 21.0	KLMH		LST
2408										19 29 24.00	18 36 48.0	AFGL		LST
2410										19 30 3.00	13 15 12.0	AFGL		LST
4251			30 3639	PLANETARY						19 32 47.55	30 24 20.3	AGK3	C	LST
2436	50 304			V391 CYG	M	405.00				19 39 27.00	48 40 18.0	GCVS		LST
4264										20 20 9.00	39 46 6.0	AFGL		LST
2566	60 286	7805	63 1618	GC 28340			K5	IRC	7	20 20 29.04	63 49 10.6	SAO		LST
2567	0 473		-0 3991	DO 6708			M4	DO		20 20 44.89	- 0 36 50.6	SAO		LST

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
1857					1.9														
4224						-1.3	-3.4	-7.0											
4226							-3.1	-6.2											
4227					1.9														
1960	9.10	IRC	5.89	2.35	1.4	-.4													
1963							-3.6												
4231								-6.6											
1981	9.80	DO	5.24	1.87	1.5														
1969					1.7														
4232						-1.2	-3.2												
1991	11.30	LWD	8.97	2.69	1.5														
2143					1.6	-1.4	-3.3												
2153						-.9	-3.7												
2160							-3.1												
2161						-1.1	-3.8												
2171	12.00	JYCE			1.5	-1.2	-3.1												
2172					1.4														
2174					1.4	-1.1	-3.1		23/ 6/78	4.12	2.63	1.68	.44	-.22	-.68	-.96			RDG
2174									26/ 7/79					-.29					RDG
2174									18/ 4/80	4.04	2.57	1.83	.48	-.03	-.37	-.77	-1.10		RDG
4238	6.32	HR			1.6														
2184	6.82	GC			1.4														
2185			8.83	2.47	1.6	-1.1													
2188						-1.0													
2191					1.5														
2193						-1.2	-2.7												
2194						-1.0	-3.5												
2195					1.8	-.7	-3.6												
2199					1.8	-1.3	-3.5		23/ 6/78	2.42	.51	-.40	-2.20	-2.62	-2.93	-2.94	-4.03		RDG
2199									5/ 8/78	2.50	.51	-.43	-2.17	-2.31	-2.95	-3.03	-3.64		RDG
2199									18/ 4/80	2.76	.67	-.47	-2.23	-2.60	-3.02	-3.16	-4.10		RDG
2202						-1.3	-3.5												
2207						-1.2	-3.8												
2211					1.8	-1.1	-3.1												
2214	8.20	IRC	5.13	1.54	1.4														
2220	6.08	IRC	4.55	2.16	1.4														
2228	10.10	DO	6.09	1.70	1.5														
2229			7.26	2.02	1.5	-1.0													
2380						-1.4	-3.1												
2388			7.25	1.96	1.5		-3.0												
2389	6.60	DO	5.11	1.91	1.5		-2.9												
4249						-1.4	-3.2												
2403					1.4	-1.0	-3.0												
2408						-.9	-3.2												
2410							-2.7												
4251	9.30	AGK3				-1.3	-3.6												
2436			7.80	2.76	1.8	-.4													
4264						-.8	-3.0	-6.4											
2566	5.79	IRC	4.52	1.98	1.4														
2567	7.50	IRC	4.99	2.08	1.7	-.9													

GL	IRC	HR	BD	OTHER	TYPE	PERIOD	SP TYPE	SOURCE	LUN	R.A. 1950.00	DEC. 1950.00	SOURCE	COMMENT	CLASS
2569	50 326									20 21 13.00	51 51 24.0	IRC		LST
4266										20 24 2.00	- 6 28 6.0	AFGL		LST
2579				V1324 CYG						20 25 19.00	39 53 6.0	AFGL		LST
2596	40 428		39 4223	DO 19093			M5	DO		20 29 46.38	39 42 36.0	SAO		LST
2600	40 427						M2	DO		20 29 41.00	40 29 6.0	IRC		LST
4267										20 29 58.00	38 48 0.0	AFGL		LST
2599	60 292			BF CEP	M	427.00	M7	GCVS		20 30 29.00	62 47 12.0	GCVS		LST
2612										20 33 32.00	41 4 18.0	AFGL		LST
4268										20 33 49.00	- 8 44 18.0	AFGL		LST
2616										20 35 0.00	41 24 54.0	AFGL		LST
2620										20 36 31.00	41 55 42.0	AFGL		LST
2629	0 467			SVS 103015			M4	DO		20 38 21.00	1 0 18.0	SVS		LST
2631										20 39 26.00	41 40 24.0	AFGL		LST
2756	20 507			BH PEG	M	426.00	M6	GCVS		21 21 3.00	23 15 18.0	GCVS		LST
4274										21 25 34.00	10 15 48.0	AFGL		LST
4276										21 29 34.00	-27 47 36.0	AFGL		LST
2777										21 29 39.00	60 39 36.0	AFGL		LST
2769				V645 CYG	L		O8	H&L		21 38 10.61	50 0 42.6	LADA		LST
2769														
2769														
2769														
2789														
2789														
2789														
2769														
2789														
2789														
4290										22 20 37.00	- 2 46 0.0	AFGL		LST
2904	50 430			DO 41372			M5	DO		22 24 53.00	45 9 6.0	IRC		LST
2911	10 518	8562	8 4874	36 PEG			K5	IRC	7	22 26 38.19	8 52 23.2	SAO		LST
4291	80 54		76 865	DO 41700			M4	DO		22 35 43.78	77 20 22.9	SAO		LST
2936	40 518			DO 41783			M7	DO		22 39 32.00	42 17 0.0	IRC		LST
3102	50 465		50 4054	SVS 8858			F8	IRC		23 26 57.70	50 56 39.2	SAO		LST
3111										23 30 20.00	31 57 0.0	AFGL		LST
3114	30 513	8943	30 4978	SVS 103124			K4	IRC	3	23 31 28.03	31 2 57.2	SAO		LST
3128										23 38 18.00	70 7 12.0	AFGL		LST
4300	40 542						M7	VOGT		23 38 13.00	44 31 36.0	IRC		LST

GL	VIS	SOURCE	I'	K	4	11	20	27	D/M/Y	2.3	3.6	4.9	8.7	10.0	11.4	12.6	19.5	23.0	OBSVR
2569			7.25	2.27	1.6		-3.9												
4266							-3.4												
2579						-1.2	-3.1												
2596	8.90	IRC	5.85	2.16	1.5														
2600			8.34	2.44	1.5		-3.6												
4267						-.7	-3.1	-5.8											
2599	11.00	DO	6.97	2.25	1.6		-3.5												
2612						-1.2	-3.3												
4268							-3.3												
2616						-1.3	-3.7												
2620					1.8	-1.3													
2629	11.00	DO	6.30	2.03	1.4	-.3													
2631						-1.3	-3.4												
2756			6.62	3.12	1.4	-.7													
4274							-3.6	-6.7											
4276							-3.6												
2777					1.4														
2769	14.00	H&L				-1.4			12/ 6/78	4.67	2.25	.98	-.60	-.97	-1.26	-1.75	-2.86		RDG
2783									18/ 6/78	4.43	2.01	.61	-.93	-1.31	-1.56	-2.06	-3.51	-4.20	JAH
2789									22/ 6/78	4.60	2.22	.94	-.65	-.95	-1.26	-1.77			RDG
2769									4/ 8/78	4.60	2.15	.69	-.68	-1.19	-1.33	-1.89	-2.87		RDG
2769									5/ 8/78	4.45	2.02	.73	-.78	-.99	-1.28	-1.97	-2.83		RDG
2789									16/ 8/78	4.85	2.42	1.13	-.49	-.97	-1.24	-1.86	-3.40		RDG
2789									26/ 7/79					-1.14					RDG
2789									27/ 7/79	4.94	2.42	1.04	-.57	-1.03	-1.18	-1.73	-2.75		RDG
2759									4/10/79	4.73	2.37	1.01	-.61	-.98	-1.21	-1.79	-2.99	-3.43	RDG
2769									17/ 4/80	5.00	2.58	1.22	-.43	-.74	-1.00	-1.64	-2.85		RDG
4290					1.5	-.9													
2904	10.30	DO	6.02	1.90	1.4														
2911	5.58	IRC	4.24	1.85	1.4														
4291	8.00	IRC	5.63	2.28	1.6														
2936	11.10	DO	6.93	2.26	1.5														
3102	9.80	IRC	7.24	2.45	1.6														
3111					1.5														
3114	4.96	IRC	3.91	1.76	1.4														
3128					1.5														
4300			7.56	2.66	1.6														

TABLE 4

Comments on Individual Sources in Tables 1, 2, and 3.

GL#	COMMENT
85	A 8' x 8' box has been searched for point sources to N ≅ +0.5, none found.
326	(W3) Has been mapped extensively, see Hackwell et al. (1978).
328	(W3-N) Extended object in AFGL catalog.
359	Sharpless 145.
361	A 8' x 8' box has been searched for point sources to N ≅ +0.5, none found.
489	CIT 5.
505	(U Cam) The period of Variability is approximate (GCVS).
585	Sharpless 222.
601	(Alpha Tau) Used as a standard star, the standard magnitudes are given.
614	(DM Eri) A binary star, the difference of the magnitudes of the components is $.3^m$, the separation is $4''$ (GCVS).
800	Sharpless 240.
807	(NCG 2024) Has been previously mapped, see Grasdalen (1974).
933	I' magnitude is variable (IRC).
945	(V Lyn) Periods of 55 and 87 days replace one another. UU Her type. Slow nonperiodic oscillations also observed (GCVS).

968	(GL Mon) The period of varability is approximate (GCVS).
1117	(XX Gem) K magnitude is variable (IRC).
1145	(KQ Pup) Multi-component system, late component is a spectroscopic binary with a period of 27 years (GCVS).
1151	(DU Pup) The period of variability is approximate (GGVS). M5 and M6 spectral type stars found near this position by Hansen and Blanco (1975).
1254	A 4' x 4' box has been searched for point sources to M $\cong$ +2.5, none found.
1261	A 8' x 8' box has been searched for point sources to N $\cong$ +0.5, none found.
1263	A 8' x 8' box has been searched for point sources to N $\cong$ +0.5, none found
1278	A 4' x 4' box has been searched for point sources to M $\cong$ +2.5, none found.
1281	(AK Hya)The period of variability is approximate (GCVS).
1282	Has an abnormally strong red end sharply cutoff by a deep absorption at λ = 6195 Å (DO).
1417	A 12' x 12' box has been searched for point sources to [Q] $\cong$ -2.5, none found.
1423	I' magnitude is variable (IRC).
1424	A 8' x 8' box has been searched for point sources to N $\cong$ +0.5, none found.
1482	(T Crt) The period of variability is approximate (GCVS).
1554	(BK Vir) The period of variability is approximate (GCVS).
1627	(R Hya) Period varies strongly; SiO maser (GCVS).

1634	A 10' x 10' box has been searched for point sources to $N \cong +0.5$, none found.
1642	K magniude is variable (IRC).
1773	CIT 7.
4217	A 6.5' x 6.5' box has been searched for point sources to $N \cong +1.0$, none found.
4222	A 6.5' x 6.5' box has been searched for point sources to $N \cong +1.0$, none found.
1862	K magnitude is variable (IRC).
1868	(R UMi) I' magnitude is variable (IRC).
1971	(TW Oph) This star is connected with a variable nebula (GCVS).
1988	CIT 9.
2162	(UY Sct) Has noticable polarization (4%). Also has IR excess which is probably due to a dust envelope (GCVS).
2165	MWC 297.
2164	K magnitude is variable (IRC).
2166	I' magnitude is variable (IRC).
2168	IRC source was not found in survey by Hansen and Blanco (1975).
2177	(W40) See Zeilik and Lada (1978). WIRO coordinates are given for IRS 2.
2190	A 6.5' x6.5' box has been searched for point sources to $N \cong +1.0$, none found.
2203	(RX Sct) Connected with the bright hydrogen nebula YM 13 (GCVS).

2208	(Alpha Lyra) Used as a standard star, the standard magnitudes are given.
2210	This source has been mapped and is seen to be a region of extended IR emission (unpublished).
2213	(X Oph) Visual binary with appreciable orbital motion; companion has spectral type K1 III (GCVS).
2215	I' magnitude is variable (IRC).
2223	Hansen and Blanco (1975) report that there are 4 faint M stars within 1.5' of this position.
2227	Hansen and Blanco (1975) report that this star is reddened.
2230	Vogt (1973) found many other possible late type stars in this field.
2233	IRC source was not found in survey by Hansen and Blanco (1975).
2376	A 6.5' x 6.5' box has been searched for point sources to N $\cong$ +1.0, none found.
2378	A 6.5' x 6.5' box has been searched for point sources to N $\cong$ +1.0, none found.
2379	A 6.5' x 6.5' box has been searched for point sources to N $\cong$ +1.0, none found.
2381	(W51) Has been extensively mapped, see Hackwell et al. (1982).
2414	(EP Vul) The spectral type is alternatively K5e (GCVS).
4251	Also known as Campbell's variable nebula or Campbell's hydrogen envelope star.
2426	(BG Cyg) K and I' magnitudes are variable (IRC).

2433	A 8' x 8' box has been searched for point sources to M ≅ +2.3, none found.
2565	Photometry is for Gamma Cyg.
2570	K and I' magnitudes are variable (IRC).
4265	A 8'x8' box has been searched for point sources to [Q] ≅ -2.5, none found.
2578	A 6.5'x6.5' box has been searched for point sources to N ≅ +1.0, none found.
2583	(KZ Cyg) K and I' magnitudes are variable (IRC).
2584	(Sharp. 106) Has been mapped and is seen to be a multiple source object in a extended region of IR emission, see Gehrz et al. (1982).
2586	A 6.5'x6.5' box has been searched for point sources to N ≅ +1.0, none found.
2617	K magnitude is variable (IRC).
2624	W75 S
2771	K and I' magnitudes are variable (IRC).
2781	CIT 13.
2924	A 6.5'x6.5' box has been searched for point sources to L ≅ +3.7, none found.
2925	(W Cep) There are features of a dust shell and a hot component in the spectrum (GCVS).
3099	This source has been discussed in Gehrz et al. (1978).
3119	A 10'x10' box has been searched for point sources to [Q] ≅ -1.6, none found.

3122 (Lambda And) Spectroscopic binary with period of 20.52 days. Brighter component is a semi irregular variable with mean period of 55.82 days (GCVS).

3126 (SVS 8872) I' magnitude is variable (IRC).

TABLE 5

Long Lambda Sources Associated With H II Regions or Dark Clouds

GL #	Designation
326	W3
328	W3N
781	involved in Orion Nebula
779	Orion Nebula (Trapezium Region)
806	NGC 2023
807	NGC 2024
1855	ρ Oph dark cloud
4222	ρ Oph dark cloud
2147	G 18.1 - 0.3
4237	G 18.3 - 0.4
2157	W 39
2169	G 20.7 - 0.1
2177	W 40
2190	G 24.5 + 0.5
2200	G 24.8 + 0.1
2210	W 42
2376	G 49.0 - 0.3
2378	G 49.4 - 0.3
2379	G 49.2 - 0.3
2381	W 51
2578	G 78.1 + 0.6

2584	Sharpless 106
2586	G 79.3 + 1.3
2593	W 69
2602	G 79.3 + 0.3
2621	W 75 North
2624	DR 21
2625	DR 22

TABLE 6

Rejected Long Lambda Sources.

GL #	4	11	20	Reason for rejection
85		-1.5		Search; this paper
361		-2.0	-3.1	Search; this paper
1164			-4.8	Seen only once by AFGL
1261		-1.5		Search; this paper
1263		-1.8		Search; this paper
1417			-4.7	Search; this paper
1424	1.8	-1.7		Search; this paper
1426			-4.6	Seen only once by AFGL
1493		-2.8		Search by Lebofsky et al (1978).
1634		-1.5		Search; this paper
4217	1.5	-1.9	-3.3	Search; this paper
2152		-1.5		Search by Lebofsky et al(1978).
2433	1.7	-2.1	-2.2	Search; this paper
4265			-4.0	Search; this paper
3119			-4.4	Search; this paper

TABLE 7

Luminosity of M = -9 Star as a Function

of Effective Temperature

T_{eff}(K)	$L/L_\odot(10^4)$
4500	3.4
4000	2.5
3500	1.8
3000	1.3
2500	0.8

TABLE 8

Luminosity of $M_{10} = -12$ as a Function of Effective Temperature

T_{eff}(K)	$L/L_{\odot}(10^4)$
1400	2.54
1200	1.77
1000	1.19
800	0.76
700	0.60
600	0.48
500	0.39
400	0.34
300	0.36

FIGURE CAPTIONS

Fig. 1 - The AFGL rocket observations at 4 μm have been plotted against the average of ground based measurements at 3.6 and 4.9 μm.

Fig. 2 - The AFGL rocket observations at 11 μm have been plotted against the 10 μm ground based measurements.

Fig. 3 - The logarithm of the number of sources brighter than a given value of [4] has been plotted as a function of [4]. The dots are from the LL list only. The crosses are the results expected from the FMO catalog based on our survey of every eighth entry in the FMO list.

Fig. 4 - The same as fig. 3 for [10].

Fig. 5 - These two plots show the distribution of [4]-[11] colors for two magnitude limited samples drawn from the LL catalog. The upper panel is for a sample magnitude limited at 10 μm, while the lower panel is for 4 μm. The areas under the histograms are equal in the two panels.

Fig. 6 - The latitude distribution of the 10 and 4 μm magnitude limited samples from the LL catalog. Note that the 10 μm sample is more concentrated to the galactic plane than the 4 μm sample. The thin lines correspond to models of the galactic distribution of the two classes of sources.

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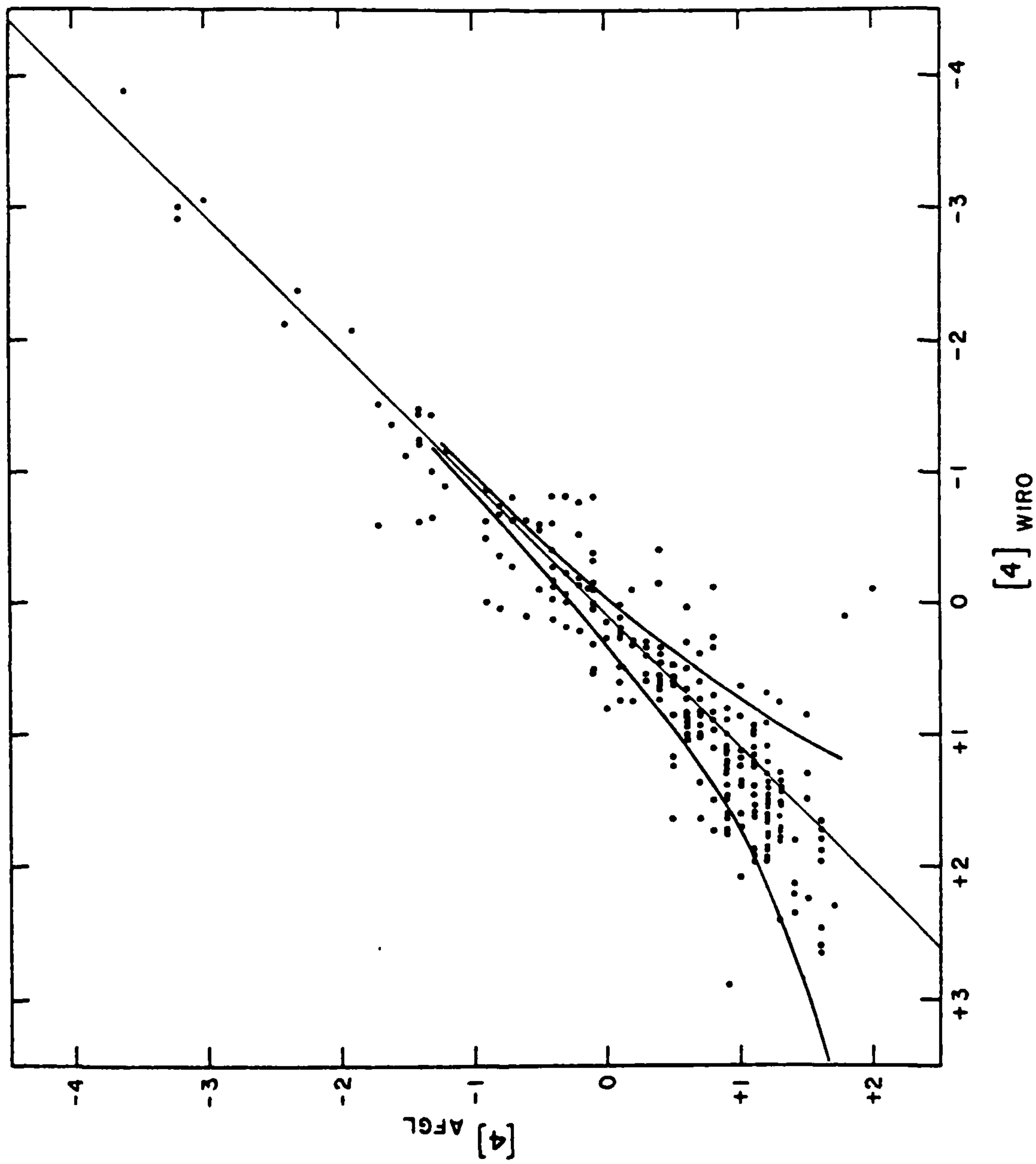

Fig. 1

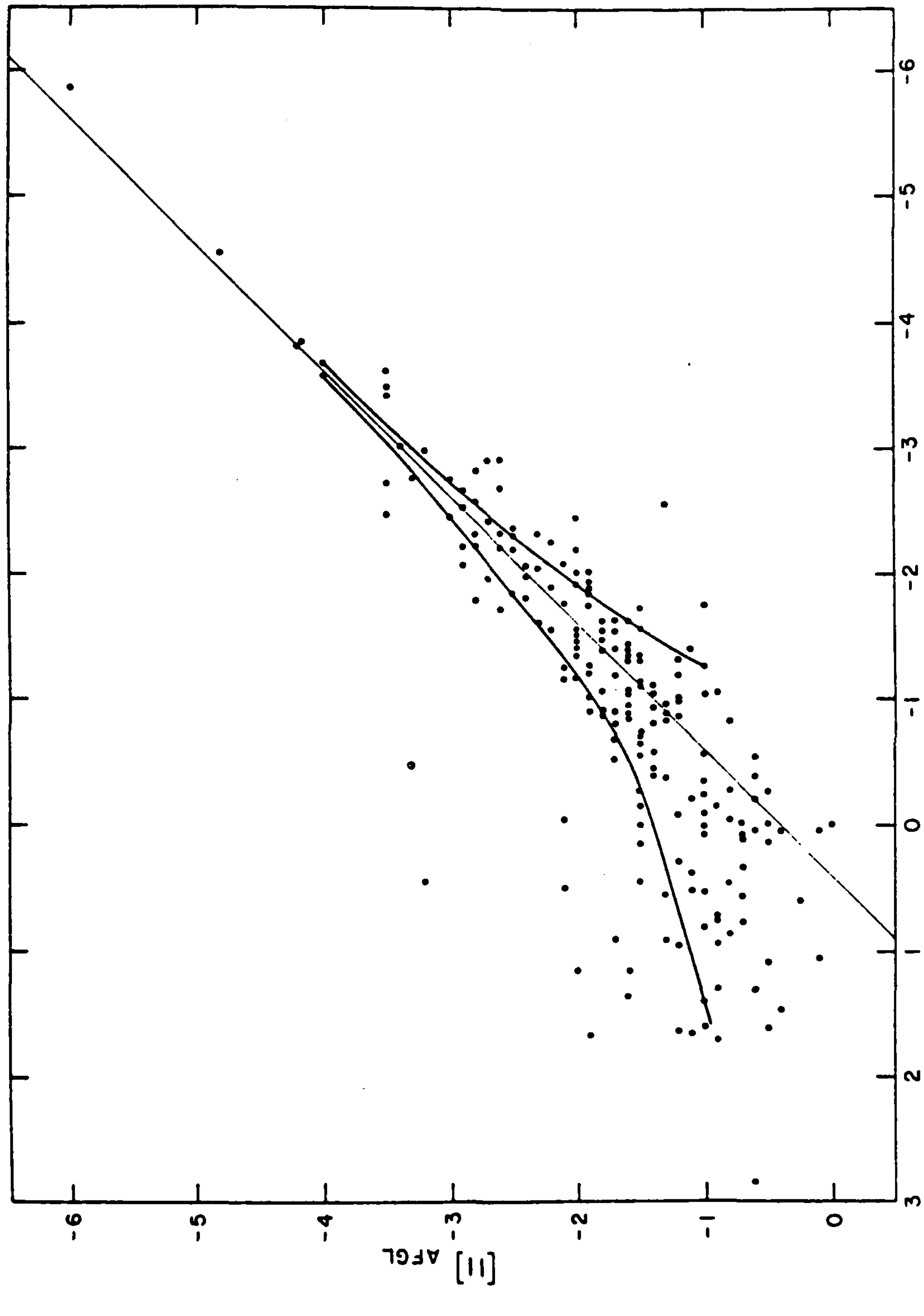

Fig. 2

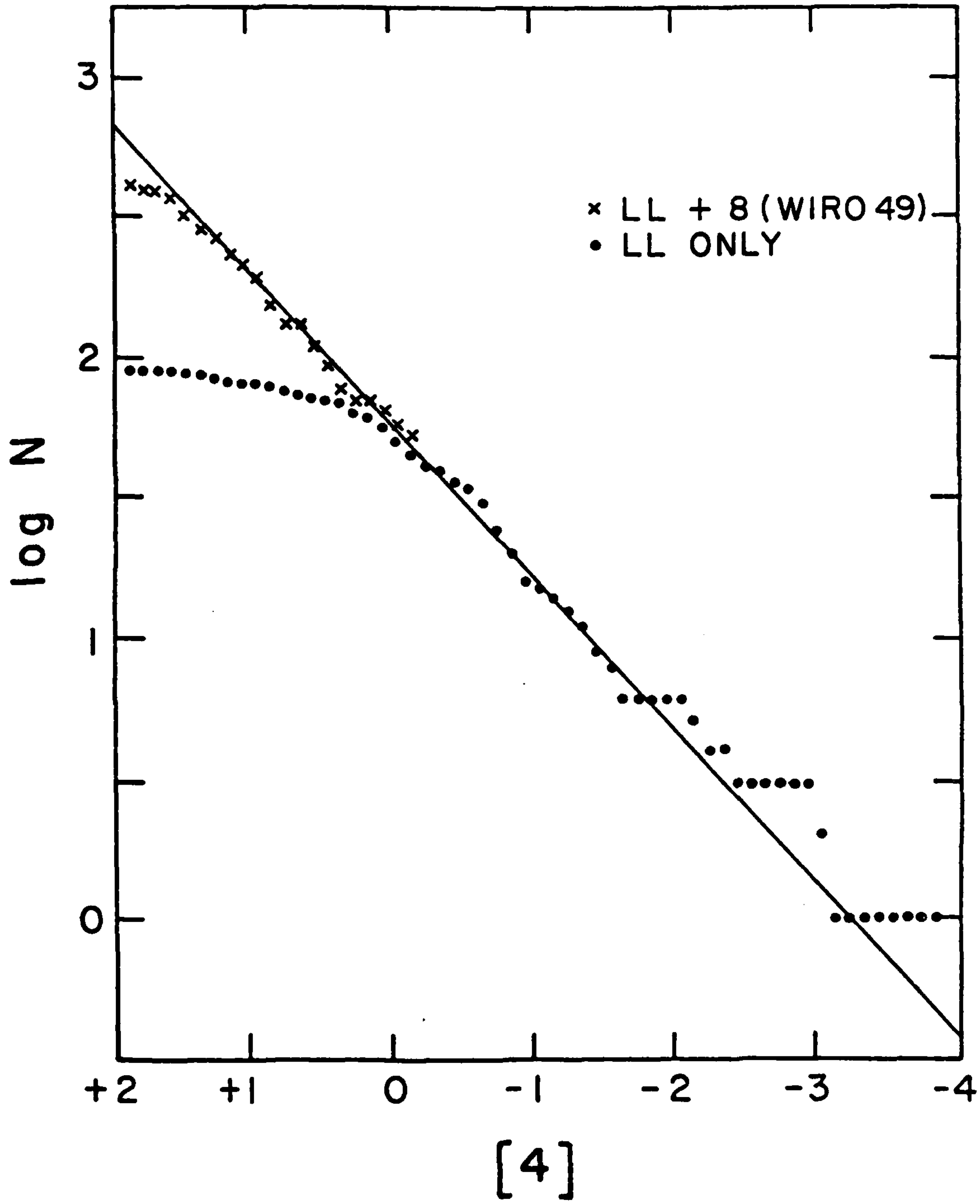

Fig. 3

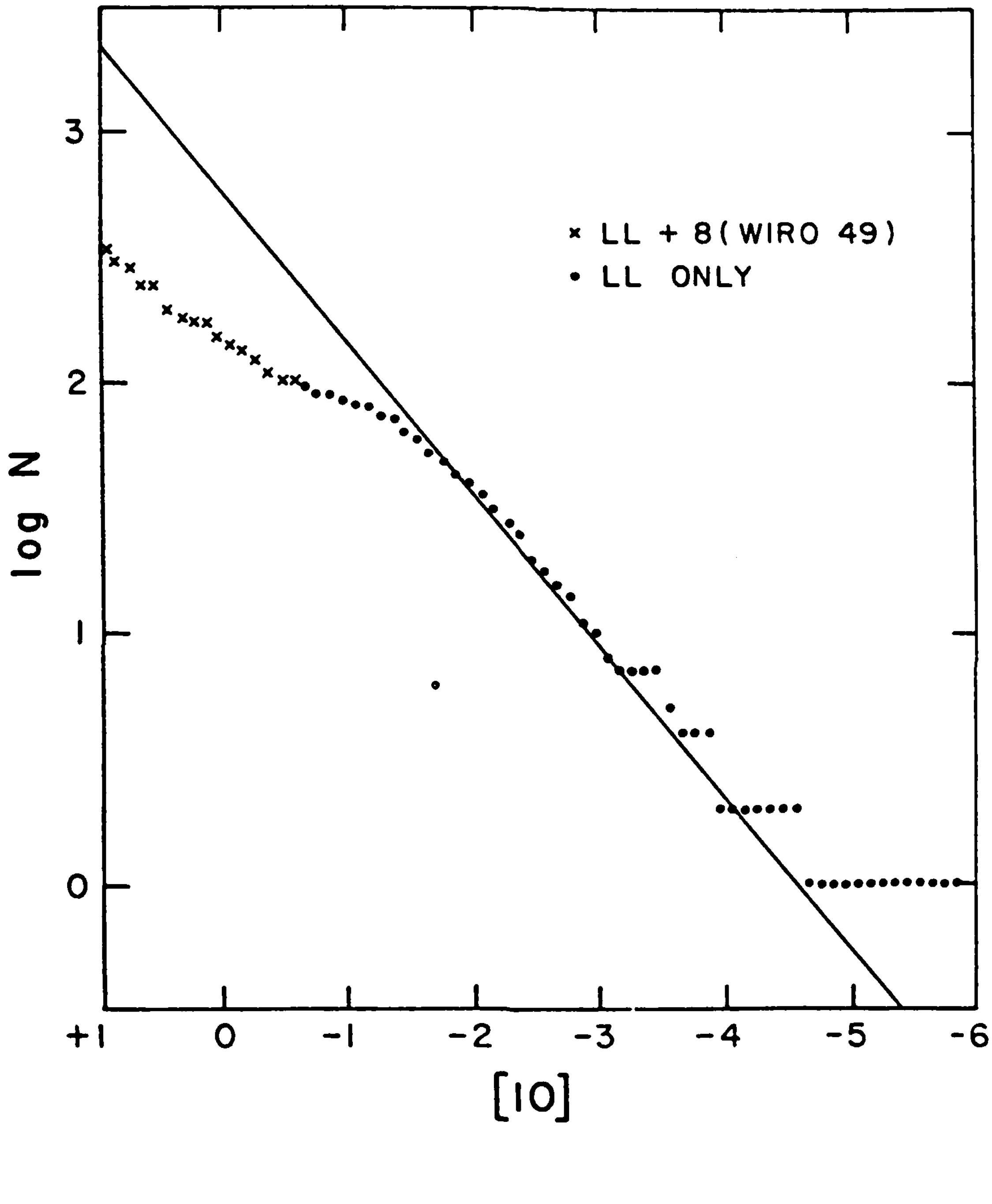

Fig.4

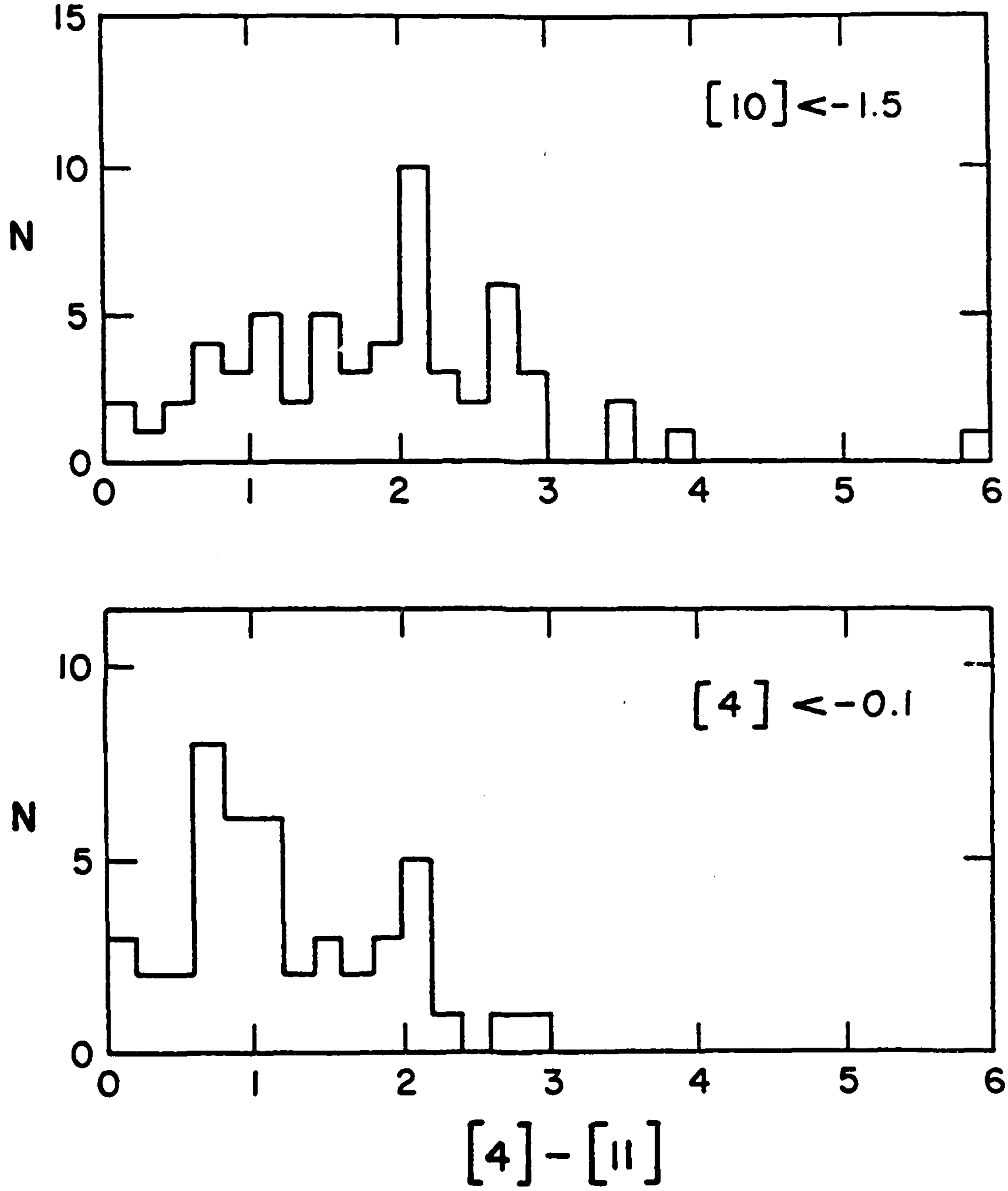

Fig. 5

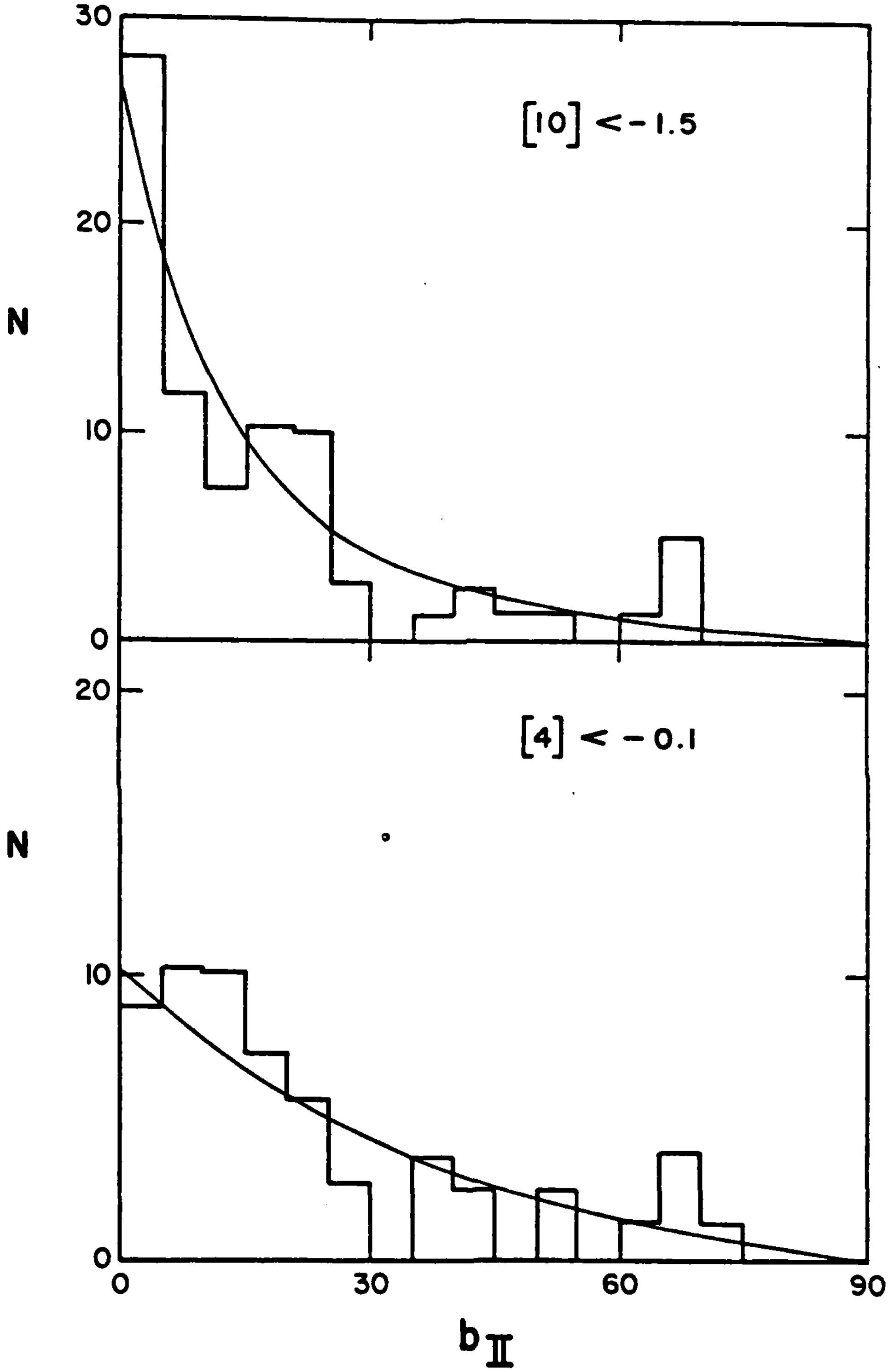

Fig. 6

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Infrared Spectra and Interstellar Reddening of Anonymous Type II OH/IR Stars

by

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ABSTRACT

We report infrared positions and multicolor infrared photometry for a sample of type II OH/IR stars. The infrared colors and 11.4 μm silicate optical depths of the low-latitude sources in this group increase as a function of distance, suggesting that interstellar reddening must be taken into account in assessing their infrared energy distributions. Reddening gradients between 1 and 3 times higher than the mean gradient in the direction of the galactic center are required to account for the observed color-distance correlation, a fact which might be explained by these stars' confinement to spiral arms.

I. INTRODUCTION

All-sky surveys for Type II OH maser sources (e.g., Caswell and Haynes 1975; Johansson et al., 1977a and b; Bowers 1978a and b; Bowers and Kerr 1978; Baud et al. 1981) -- those radiating principally at 1612 MHz -- have shown that these objects are highly concentrated toward the galactic plane and the galactic center. For this reason, and because their double-peaked velocity structures suggest an origin in expanding circumstellar envelopes, it is thought that these masers are probably associated with late-type stars in a relatively young population.

Efforts to confirm hypotheses regarding their evolutionary status have included searches for the stellar sources which (it is presumed) excite the masers, along with spectroscopy and time series observations of the identified sources (Evans and Beckwith 1977; Schultz, Kreysa, and Sherwood, 1976; Engels 1982; Jones et al., 1982). The searches for these stellar counterparts have been carried out exclusively at infrared wavelengths, a strategy which is based on extrapolation of the properties of the stars already known to exhibit OH maser emission: the redness of their continua is correlated with the strength of their OH maser emission (Hyland et al. 1972), a phenomenon attributed to the fact that both parameters depended on the mass of the stars' circumstellar envelopes. In fact OH masers identified through these infrared searches have been found to be extremely red, sometimes exhibiting strong absorption features near 10 m, attributable to silicate dust in massive circumstellar envelopes (Evans and Beckwith 1979). This result suggests that the OH/IR stars found in radio surveys might represent a more advanced stage of evolution of Mira variable stars than Miras previously detected as OH maser sources.

Only a fraction of the OH sources found in the sky surveys have been identified in these studies. Partly because this number is so small, continued searches for stellar counterparts to OH masers along with efforts to determine the properties of identified soruces are warranted. Such work should address the questions of (1) whether some OH masers may represent even more extreme states of Mira evolution than any that have so far been identified, and (2) whether the OH maser emission might also be produced by a different class of object.

In this paper, we report results of a program to search for additional stellar counterparts to OH masers, and to determine continuum properties for a number of previously identified masers. Our observations and analysis focus particularly on identifying the effects of interstellar dust on the observed properties of OH/IR stars, in order to permit a direct comparison of their properties with archetypical Miras and M-type supergiant stars.

II. Observations

Telescopes and equipment at Kitt Peak National Observatory and Wyoming Infrared Observatory were employed to search for infrared counterparts to OH sources found in radio sky surveys and listed by Bowers (1978b) as optically unidentified (anonymous) OH/IR sources having double-peaked velocity structure. Sources were selected on the basis of OH brightness, the precision of the best available radio position, and availability in the sky.

The observations at Kitt Peak were done on the 1.3-m telescope with a liquid-nitrogen-cooled InSb photovoltaic detector system in 1978 June and 1979 July. Several attempts were made to find an optimum combination of wavelength and beam-size to search for the infrared sources. Observations through a broad-band 2.2 μm filter provided good sensitivity even with relatively large beam sizes, but were often plagued by source confusion. On the other hand, observations through a broad-band 3.8 μm filter with a 22" aperture were severely background-noise limited. Ultimately, scans were made at as many wavelengths as time permitted; either an 11" or 22" beam was used, depending on the wavelength. Areas of ± 2 times the radio error boxes of the OH sources were raster scanned with the reference beam set greater than 30" south of the signal beam to increase the effective area searched. Beyond this positional selection, an attempt to avoid confusion of highly reddened field stars with <u>bona fide</u> OH/IR stars was made on the basis of near-infrared (1 to 5 μm) photometry of all sources detected in the radio error boxes: sources found to have K - L colors $\lesssim$ 1 mag. were ruled out as possible counterparts to the OH masers. This somewhat arbitrary limit lies near the blue extreme of the colors of stars that had previously been found to exhibit OH emission. Nonetheless, by combining this color limit with the brightness limit of our search (K $\lesssim$ 11 mag.), we expect no chance detections of normal field stars earlier than spectral type K and reddened by diffuse interstellar clouds if these clouds cause $\lesssim 4$ mag kpc^{-1} of visual extinction.

Further searches for infrared counterparts to the OH sources were done with a Wyoming multi-filter infrared photometer equipped with a Wyoming-constructed Ga: Ge bolometer mounted at the Cassegrain focus of the 2.34 m Wyoming Infrared Telescope. In this case, a 10 μm (N band) filter, a 5" beam and a 10" throw between source and reference beams were used. This work resulted in improved positions for several of the sources that had originally been found at Kitt Peak.

Positions for sources found in our searches were measured with respect to the nearest SAO stars. Since none of these OH sources were found to be extended with respect to our beam the largest uncertainty in these relative position measurements is the location of the beam center, which is estimated to be accurate to ± one half of the beam size. The most precise positions measured for the sources are listed in Table 1, along with the photometric system and beam size used to obtain each measurement. For comparison, we have included the best available radio positions in the table.

Multi-color photometry of each of the OH/IR sources identified in this way, was obtained with the same telescopes and equipment used to carry out the searches (see table 2). These results are listed in Table 2. The Kitt Peak photometry was calibrated using standards from Johnson et al. (1966), while the calibration of the Wyoming system has been given by Gehrz, Hackwell and Jones (1974). Except where noted, statistical uncertainties of the measurements and uncertainties in the air mass corrections are ± 5% for measurements made at $\lesssim 5\,\mu m$, ± 10% for measurements from 8.7 to 12.6 μm, and 20% for measurements at 19.5μ m. Two additional OH/AFGL sources (see Price and Walker, 1976) for which we have obtained 2.3 -23μ photometry at Wyoming have been included under a separate heading in Table 2 as comparisons for the anonymous Type II masers selected from Bowers' survey. These are OH 232.3 + 18.1 (GL1274) and OH 334.8 + 50.1 (GL 1686).

Repeated observations were obtained for most of the sources studied in order to test for Mira-like variations; i.e. characterized by large amplitudes ($\gtrsim$1 mag.) and long periods ($\gtrsim$1 year). Several of the sources were found to vary with amplitudes between 1 and 2 mag. at all wavelengths: OH 18.8+0.4, OH 23.1-0.3, OH 28.7-0.6, OH 32.0-0.5, OH 39.7+1.5, and OH 39.9-0.0. Evans and Beckwith (1977) have observed variations in OH 45.5+0.1 and their data combined with ours suggests an amplitude of $\gtrsim$1 mag at all infrared wavelengths. Smaller amplitude but significant variations were recorded for OH 24.7+0.3, OH 35.6-0.3, and OH 127.8+0.0. If it is assumed that all light variations are roughly in phase, then the light amplitude was generally found to decrease with increasing wavelength for all variable sources observed. Our data for several sources measured more than twice are consistent with the rather long periods expected for OH/IR Miras (Dickinson et al., 1975; Engels, 1932). Shorter periods are, however, not necessarily ruled out by our data. Detailed studies of the temporal behavior of a number of stars in table 2, carried out by Engels (1982), confirm that their periods are long.

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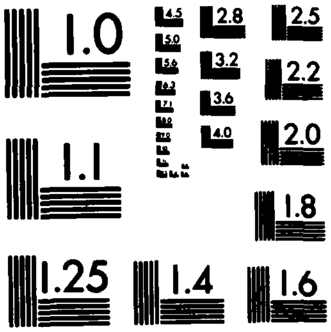

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Engels (1982) has observed several sources which appear in our list for infrared variations and reports long period variations for them; periods for these are given in table 3.

III. Distances and Galactic Distribution of Observed Sources

Kinematic distances for each of the OH sources in our study were computed by assuming (1) that the velocity at the mid-point of their double-peaked velocity patterns represents the center of mass velocity V_{LSR} of each star, and (2) that the observed motion is due entirely to circular motion of a source about the galactic center. These are given in Table 3. The values taken for the distance and velocity of the sun with respect to the galactic center are from Schmidt (1965): $R_o = 10$ kpc, and $\theta_o = 250$ km/s. The ambiguity in distances deduced by this method in the first and fourth galactic quadrants was resolved by presuming that the near kinematic distance (NKD) is the appropriate value, an assumption which is justified by the lower probability of detecting objects at the far kinematic distance.

The expected accuracy of kinematic distances deduced from this galactic rotation model has been studied extensively. Most recently Baud et al. (1981), have found a correlation between the separation of OH velocity peaks and the r. m. s. deviation of the OH velocity centroid from that predicted using a galactic rotation model: sources with $\Delta V_{OH} \gtrsim 29$ km/s were found to deviate by $\gtrsim 10$ km/s from circular galactic rotation. Most of the stars included in our study have such large OH velocity separations, and are therefore presumed to follow circular galactic orbits closely.

Using the derived kinematic distances given in table 3 our sources are shown projected on the galactic plane in Figure 1. Fourteen of the sources lie in the first quadrant along the tangential direction of the Scutum arm of the galaxy ($\ell^{II} \sim 30 \pm 15°$), while one (OH 127.8+0.0) lies in the anti-center direction. The range of near kinematic distances represented by these objects is large (1.3 to 7.7 kpc). Their galacto-centric distances (GCD) range only from 6 to 9 kpc. except for the single anti-center source OH 127.8+0.0 which has a GCD of 12.8 kpc.

Radio surveys have shown that the Type II OH maser sources can be characterized by the velocity separation, ΔV, between the two features in their OH maser spectra; that is, sources with similar separations tend to have similar galactic distributions and kinematics (see for example Habing, 1977). The mean of this parameter for all anonymous OH sources found in Bowers' survey was $\sim$30 Km/s, and the half-width of the distribution was $\sim$20 Km/s. The mean velocity separation for sources included in this study was $\sim$32 Km/s, and the half-width of the distribution of velocity separation was $\sim$ 10 Km/s. Thus, our sources are not an extreme subset of those found in radio surveys, and correlations of physical properties among them should be representative of the majority of sources found in those surveys.

IV. Apparent Spectral Energy Distributions

Infrared continua of two prototypical OH/IR stars, the Mira variable IK Tau and the supergiant VX Sgr, are shown in Figure 2. Continuum observations of the two high galactic latitude sources observed in this study are also included in the figure. The infrared energy distributions of these sources are similar: their 2 - 20 μm color temperatures exceed 1000 K, and all exhibit silicate emission features near 11 μm.

Energy distributions for all 15 of the low galactic latitude OH/IR stars in our study are plotted in Figure 3. These stars differ generally from those shown in Figure 2 by having significantly redder continua, with 2-20 μm color temperatures below 700 K; in addition, almost all of them exhibit the silicate feature in absorption.

It is not clear, *a priori*, to what extent the excess reddening and strong silicate absorption in these low-latitude OH/IR stars is caused by heavy obscuration due to intervening interstellar dust, or by emission and reddening due to dust in dense circumstellar envelopes; the interstellar medium contains dust grains that are similar to those present in the envelopes of late-type oxygen-rich stars. Anticipating our discussion of these alternatives in the following Sections, we have plotted the spectra in Figure 3 with vertical offsets in decreasing order of their distance. Interstellar effects are apparent, in that stars nearer than 3 Kpc are detected with silicate features having optical depths less than ~ 0.5, while all the more distant stars have optical depths exceeding ~ 0.5.

V. Effects of Interstellar Reddening

We have examined the possibility that the extreme redness of the previously unidentified OH/IR stars might be due to interstellar dust as suggested by figure 3. Three reddening-sensitive parameters are plotted against NKD in Figures 4a, b, and c; all of the sources listed in Table 3 are included in the figures. Two effects produce scatter in the data. One is the variability of the stars themselves; variations observed by us and Engels (1982) are indicated in the figures by "error bars" which show the maximum range in observed parameters for each source. Additional scatter in these figures results from the contribution to the stars' continua by the emission of circumstellar dust; one would expect, by analogy to the prototypical OH/IR stars (Figure 2), that this scatter should be particularly evident for the measures made at wavelengths $\geq 5\ \mu m$, i.e., Figures 4b and 4c. In the presence of scatter from these effects, the figures nonetheless show an apparent correlation between distance and all three of the reddening sensitive parameters plotted.

To test whether the extreme reddening of the OH/IR sources in our study resulted primarily from the reddening and long-wavelength emission of circumstellar dust, we must compare their colors to parameters which are related to the column densities of dust in their envelopes. In this respect, the available data, along with the derived NKD's, provide a direct measure of these sources' luminosities, which is presumeably related to the mass-loss rates in their radiatively driven winds (Gehrz and Woolf, 1971). Unfortunately, the range in luminosities among the observed sources is small ($\log L/L_{\odot} \sim 2.8 - 4.2$), and correlations between color or optical depth and luminosity must be masked by variability effects and uncertainties in distance within this small sample. Similarly, an attempt to seek a correlation between color and velocity separation between the sources' OH maser peaks (an indirect measure of the stellar luminosity) may be inhibited by the limited range in ΔV among the sources observed. In any case, there is no apparent correlation between parameters which might be expected to measure luminosity (M_K, L_{IR}, and ΔV) and NKD (see figure 5a-c).

As a further test that the redness of the observed sources is an intrinsic property rather than a results of interstellar reddening, we have compared their colors and silicate optical depths with galacto-centric distance (GCD). These parameters are found to exhibit a correlation with GCD similar to that observed in Figures 4a-c where they are compared to NKD; the implication of this correlation is ambiguous, however, since most of the sources observed lie wihin a narrow range in galactic longitude ($\ell_{II} \sim 30° \pm 15°$), resulting in a tight correlation between NKD and GCD. It is thus interesting that the single source in our sample, OH 127.8 + 0.0, which is not in the direction of the Scutum arm but in the anti-center direction at a GCD of 13 Kpc, is much redder than indicated by the apparent galactic gradient seen in the other sources. We conclude that our data provide no evidence for a galactic gradient in the observed colors of OH/IR stars.

VI. Discussion

The hypothesis that interstellar dust significantly affects the observed colors of OH/IR stars has been considered previously by others (Evans and Beckwith 1977; Engels 1982), but was rejected by them on the grounds that (1) the amount of extinction required to produce the red colors of the newly identified OH/IR stars was anomalously high, (2) there was insufficient evidence for any concentration of molecular clouds in the vicinities of the OH/IR stars, (3) the colors of the stars were found to vary, implying a local cause for at least a portion of their redness, and (4) the colors of the stars were found to be correlated with their periods, an effect attributable to the role that variability may play in the stars' mass loss and subsequent development of circumstellar dust envelopes.

The results presented in the preceding Section V suggest, however, that interstellar reddening may significantly affect the observed colors of OH/IR stars. The amount of reddening needed to produce the apparent correlations between observed infrared parameters and NKD is indicated in Figures 4a-c by three reddening lines, corresponding to three different values for the assumed visual extinction gradient A_V = 2, 4, and 6 mag./Kpc. The reddening law used to obtain the infrared gradients shown in Figures 4a and b was derived by Sneden et al. (1978). The silicate extinction gradient shown in Figure 4c was obtained from measures of the interstellar silicate absorption against sources at the galactic center (Hackwell, Gehrz, and Woolf, 1970; Becklin et al. 1978), and in the direction of VI Cyg NO. 12 (Gillett, Jones and Merrill 1975; Rieke 1976).

The reddening gradients that are required if interstellar dust accounts for the infrared parameters of the OH/IR stars observed in this study, 2-6 mag./Kpc, significantly exceed the "mean" value for interstellar reddening in the galactic plane, $A_V \sim 2$ mag./Kpc (Allen 1973). We propose that the high reddening gradient deduced from the colors of OH/IR stars included in this study is a result of their being located along a line of sight tangent to the Scutum arm of the galaxy. The "mean" value for the interstellar reddening gradient includes inter-arm voids, and must therefore be less than that which would be expected from observations along a spiral arm. Further, it is derived from studies which rely on measurements of optically-selected luminous stars (e.g., Johnson 1968; Hackwell and Gehrz 1974; Barlow and Cohen 1977; Sneden et al. 1978); such studies may not apply to the most heavily obscured regions of the galaxy. If this interpretation is correct, then the redness of OH 127.8+0.0 must also be due to its lying along a highly obscured part of the galactic plane.

The occurrence of these sources in highly obscured regions may be a selection effect, in which case we suggest that the identified OH/IR stars are simply those that lie along unobscured lines of sight. Their location in dusty regions may, on the other hand, result from their youth: the more massive OH/IR stars may not have travelled far from the place where they were formed before evolving to the Mira or red supergiant stage. In the latter case, one expects that the "anonymous" OH/IR stars may have more massive circumstellar envelopes -- indicating that they are more luminous and more massive stars, compared to the optically identified OH/IR stars.

VIII. Observational Tests

The question of whether or not the apparent infrared energy distributions of some anonymous OH/IR stars are significantly affected by interstellar reddening has important implications.

A number of investigators (Forrest et al. (1978), Evans and Beckwith, 1977, Bowers et al., (1980), and Bowers, (1981)) have suggested that OH/IR stars have mass loss rates $\gtrsim 10^{-5}$ to $10^{-4} M_{\odot}\ yr^{-1}$ based largely upon the assumption that the silicate absorption feature is caused entirely by self-absorption in the outer layers of an extended optically thick circumstellar thick shell. If, as suggested by our observations, the silicate absorption feature at 11.4 μm is affected by interstellar silicates, then the intrinsic mass loss rates for these objects could be lower than suggested by the earlier calculations. Corrections for reddening would lower calculated mass loss rates by reducing the shell radius and shell dust optical depth. Mass loss rates in the range 10^{-7} to $10^{-5}\ M_{\odot}\ yr^{-1}$ would be more consistent with the values currently associated with optically visible luminous M giant variables and supergiants (Gehrz and Woolf, 1971).

Although the correlations between infrared shell parameters and NKD presented herein are strongly suggestive of interstellar effects, the possibility that the effects are largely circumstellar cannot be completely ruled out. Further observational tests are required to distinguish quantitatively between the contributions of interstellar and circumstellar dust in anonymous OH/IR stars. High resolution CO measurements may help to establish the amount of molecular material along the lines of sight as an additional test for anomalous interstellar extinction. Measurements of the infrared angular diameters of OH/IR stars would provide a definitive means for comparing the intrinsic shell parameters of anonymous sources with those of other classes of OH/IR stars. Long term studies of temporal variations will be required to distinguish between the interstellar and circumstellar contributions to the apparent spectral distributions. Finally, long term proper motion studies using infrared interferrometric techniques might be expected to provide an improved understanding of the distances and galactic distribution of these sources.

Summary

Our analysis of multi-color photometry of a sample of anonymous OH/IR stars shows that their colors are extremely red, by comparison to prototypical OH/IR stars, a result which was also obtained in previous studies of this class of objects. However, we find, in contrast to earlier work, that their redness seems to be correlated with distance rather than with any intrinsic property of the stars, such as luminosity. This effect can be explained if their redness is due, at least in part, to interstellar extinction and reddening expected for A_V between 2-6 mag./Kpc along our lines of sight. These stars, thought to be younger than prototypical OH/IR stars, may tend to lie in obscured regions of the galaxy because they have not moved far from the places where they were formed.

Our results have a number of implications. First, the galactic plane has extinction over long distances that are much higher than expected from previous observations, and this fact must be taken into account is assessing its stellar structure. Second, the effects of interstellar extinction must be taken into account in determining the intrinsic properties of OH/IR stars. This means that the actual mass loss rate may be much less than other investigators have suggested. Third, unsuccessful efforts to identify OH/IR stars at infrared wavelengths $\lesssim 10$ μm may have resulted from heavy obscuration of these objects; thus searches at longer wavelengths at levels of sensitivity not much greater than the observed brightness of the identified sources, are not likely to result in many new identifications of OH/IR stars.

The results reported here can be tested further by direct observations. Long term studies of temporal variations will be required to distinguish between the interstellar and circumstellar contributions to the apparent spectral distributions.

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TABLE 1: Positional Identifications of OH/IR Sources

OBJECT	OH POSITIONS RA	OH POSITIONS DEC	NOTES	IR POSITIONS RA	IR POSITIONS DEC	System, beam for IR pos.		Date
18.8 + 0.4	$18^h21^m17^s\pm0'.25$	$-12°28'.0\pm0'.25$	h	$18^h21^m21^s.5$	$-12°27'57''$	KP	11"	07/06/78
	$18^h21^m07^s\pm15'$	$-12°26'25''\pm15'$	a	18 21 21.4	-12 27 58	W	5"	08/16/78
19.1 - 1.0	$18^h26^m39^s.9\pm5''$	$-12°39'.7\pm15''$	b	$18^h26^m39^s.9$	$-12°40'00''$	KP	16	07/03/79
23.1 - 0.3	$18^h31^m27^2\pm0'.25$	$-09°00'.9\pm0'.25$	i	$18^h31^m27^s.2$	$-09°00'20''$	KP	11"	07/07/78
				18 31 27.1	-09 00 28	W	5"	08/04/78
24.7 + 0.3	$18^h32^m45^s\pm5^s$	$-07°14'00''\pm1'.25$	e	$18^h32^m47^s.3$	$-07°15'40''$	KP	22"	07/06/78
				18 32 47.1	-07 15 42	W	5"	08/04/78
				18 32 46.8	-07 15 37	KP	16"	07/06/79
26.2 - 0.6	$18^h38^m31^s.7\pm15''$	$-06°17'54''\pm15''$	d	$18^h38^m33^s.3$	$-06°17'52''$	KP	22"	07/06/79
26.4 - 1.9	$18^h43^m45^s.0\pm1^s$	$-06°43'.8\pm15^{15}$	d	$18^h43^m45^s.4$	$-06°43'51''$	KP	16"	07/03/79
				18 43 45.2	-06 43 51	KP	16"	07/06/79
27.3 + 0.2	$18^h37^m42^s\pm0'.25$	$-06°00'.6\pm0'.25$	g	$18^h37^m41^s.5$	$-04°58'49''$	KP	22"	07/06/78
28.7 - 0.6	$18^h43^m10^s.7\pm0^s.9$	$-04°04'00\pm1'.25$	h,e	$18^h43^m10^s.7$	$-04°04'00''$	W	5"	08/16/78
				18 43 09.7	-04 03 59	KP	16"	07/05/79
30.7 + 0.4	$18^h43^m16^s.6\pm1^s$	$-01°50'00''\pm15''$	d,f	$18^h43^m16^s.5$	$-01°49'54''$	KP	16"	07/03/79

TABLE 1: (cont't)

OBJECT	OH POSITIONS RA	OH POSITIONS DEC	NOTES	IR POSITIONS RA	IR POSITIONS DEC	System, beam for IR pos.		Date
31.7 - 0.8	$18^h49^m25.^s5\pm1^s$	$-01^\circ30.'5\pm15''$	d	$18^h49^m25.^s6$	$-01^\circ30'27''$	KP	10"	07/05/79
32.0 - 0.5	$18^h48^m51.^s1\pm1^s$	$-01^\circ07.'4\pm15''$	d	$18^h48^m51.^s1$	$-01^\circ07'27''$	KP	22"	07/06/78
35.6 - 0.3	$18^h54^m56.^s\pm0.'25$	$+02^\circ07.'7\pm0.'25$	g	$18^h54^m56.^s3$	$+02^\circ08'14''$	KP	22"	07/07/78
39.7 + 1.5 (GL 2290)	$18^h56^m04.^s2\pm0.^s2$	$+06^\circ38'18''\pm34''$	f	$18^h56^m04.^s0$	$+06^\circ38'50''$	KP	-	10/75
33.9 - 0.0	$19^h01^m43.^s2\pm0.^s25$	$+06^\circ08.'8\pm15''$	d	$19^h01^m43.^s0$ 19 01 43	$+06^\circ08'46''$ +06 08 44	KP W	22" 5"	07/07/78 08/16/78
42.3 - 0.2	$19^h06^m43.^s7\pm1^s$	$+08^\circ11.'8\pm15''$	d	IR source within radio error box, position not measured more accurately		W	5"	11/21/78
45.5 + 0.1	$19^h11^m58.^s3\pm0.^s3$	$+11^\circ05'25''\pm5''$	c	IR source within radio error box, position not measured more accurately		W	5"	11/21/78
75.3 - 1.8	$20^h27^m12.^s\pm5^s$	$+35^\circ36'50''\pm1.'25$	e	$20^h27^m12.^s9$	$+35^\circ35'40''$	KP	11"	07/01/79
127.8 - 0.0	$01^h30^m27.^s7\pm0.^s5$	$+62^\circ11'30''\pm6''$	f	$01^h30^m27.^s2$	$+62^\circ11'31''$	KP	-	10/75

Notes to Table 1

a) Turner, 1970

b) Winnberg et al., 1973

c) Evans, Cruther, and Wilson, 1976

d) Johansson et al., 1977b

e) Bowers, 1978a

f) Bowers et al., 1980

g) Wilson and Barrett, 1972

h) Winnberg et al., 1975

i) Hardebeck, 1972

Table 2: New Infrared Photometry of OH/IR Sources

OBJECT	DATE	System	Beam	[1.25]	[1.65]	[2.3]	[3.45]	[3.6]	[4.6]	[4.9]	[8.7]	[10]	[11.4]	[12.6]	[19.5]	[23]
							LOW GALACTIC LATITUDE OH/IR SOURCES									
18.8 + 0.4	8/16/78	W	5"	-	-	+6.66	-	+5.07	-	+4.11	+2.64	+2.02	+1.67	+1.31	+0.16	-
	7/06/79	KP	11"	+8.49	+6.58	+5.22	+3.73	-	+2.72	-	-	-	-	-	-	-
	7/10/79	W	5"	-	-	+5.29	-	+3.76	-	+3.07	+1.54	+1.12	+0.48	+0.57	-	-
19.1 - 1.0	7/03/79	KP	16"	-	-	+10.40	+6.66	-	-	-	-	-	-	-	-	-
23.1 - 0.3	7/07/78	KP	11"	-	-	+10.70	+5.68	-	+3.79	-	-	-	-	-	-	-
	8/04/78	W	5"	-	-	-	-	5.60	-	+4.01	+2.56	+2.18	+2.36	+1.17	-	-
	7/06/79	KP	16"	-	+11.92	+8.10	+4.08	-	+2.57	-	-	-	-	-	-	-
	7/10/79	W	5"	-	-	+7.95	-	+3.98	-	+2.44	+0.72	+0.76	+0.66	-0.17	-1.00	-
24.7 + 0.3	7/06/78	KP	22"	-	+11.24	+8.38	+3.61	-	+1.73	-	-	-	-	-	-	-
	8/04/78	W	5"	-	-	+8.23	-	+3.45	-	+1.63	+0.30	+0.12	+0.26	-0.90	-	-
	7/06/79	KP	16"	-	+11.94	+7.92	+3.48	-	+1.72	-	-	-	-	-	-	-
	7/10/79	W	5"	-	-	+7.82	-	+3.37	-	+1.53	-0.04	-0.12	-0.24	-1.19	-2.20	-
26.2-0.6	7/06/78	KP	22"	-	-	+9.75	+4.54	-	+2.81	-	-	-	-	-	-	-
	7/05/79	KP	16"	-	-	-	+5.54	-	-	-	-	-	-	-	-	-
	8/16/79	W	5"	-	-	+9.44	-	+4.70	-	+2.50	+0.51	+0.42	+0.16	-0.75	-1.94	-

Table 2 (con't)

OBJECT	DATE	System	Beam	[1.25]	[1.65]	[2.3]	[3.45]	[3.6]	[4.6]	[4.9]	[8.7]	[10]	[11.4]	[12.6]	[19.5]	[23]
26.4 - 1.9	8/16/78	W	5"	-	-	+6.57	-	+3.21	-	+1.48	-0.26	-0.45	-0.66	-1.26	-2.52	-
	7/03/79	KP	16"	-	-	+7.23	+3.75	-	-	-	-	-	-	-	-	-
	7/06/79	KP	16"	-	+10.30	+7.16	+3.57	-	+2.06	-	-	-	-	-	-	-
	10/05/79	W	5"	-	-	+6.66	-	+3.07	-	+1.39	-0.29	-0.50	-0.72	-1.17	-2.28	-
27.3 + 0.2	7/06/78	KP	22"	-	-	+10.18	+5.91	-	+4.43	-	-	-	-	-	-	-
	8/16/78	W	5"	-	-	+10.83	-	+6.10	-	+4.26	+2.44+	2.29	+2.36	+1.34	+0.22	-
	7/06/79	KP	15"	-	-	+12.31	+7.74	-	-	-	-	-	-	-	-	-
28.7 - 0.6	8/16/78	W	5"	-	-	+6.52	-	+3.58	-	+2.53	+0.46	+0.18	-0.17	-0.65	-2.10	-
	7/05/79	KP	16"	+9.57	+6.89	+4.71	+2.25	-	-	-	-	-	-	-	-	-
	7/06/79	KP	16"	+9.52	+6.83	+4.72	-	-	+1.21	-	-	-	-	-	-	-
	10/05/79	W	7"	-	-	+4.83	-	+2.37	-	+1.19	-0.54	-0.93	-1.38	-1.50	-2.71	-
30.7 + 0.4	8/16/78	W	5"	-	-	-	-	+4.53	-	+1.99	+0.39	+0.30	+0.38	-0.89	-1.96	-
	7/03/79	KP	16"	-	-	+10.56	+4.59	-	+2.26	-	-	-	-	-	-	-
	7/05/79	KP	16"	-	-	+10.63	+4.51	-	+2.28	-	-	-	-	-	-	-
	7/06/79	KP	16"	-	-	+10.63	+4.51	-	+2.28	-	-	-	-	-	-	-
	10/05/79	W	7"	-	-	-	-	+4.77	-	+2.14	+0.49	+0.38	+0.55	-0.60	-1.86	-
31.7 - 0.8	7/05/79	KP	10"	+10.04	+7.60	+5.80	+4.08	-	3.47	-	-	-	-	-	-	-

Table 2 (Con't)

OBJECT	DATE	System	beam	[1.25]	[1.65]	[2.3]	[3.45]	[3.6]	[4.6]	[4.9]	[8.7]	[10]	[11.4]	[12.6]	[19.5]	[23]
32.0 - 0.5	7/06/78	KP	22"	-	-	-	+6.12	-	+3.54	-	-	-	-	-	-	-
	8/16/78	W	5"	-	-	+10.16	-	+6.28	-	+3.15	+1.11	+0.99	+1.44	-0.27	-1.47	-
	7/06/79	KP	16"	-	-	-	+7.96	-	+4.69	-	-	-	-	-	-	-
	10/05/79	W	7"	-	-	-	-	+7.83	-	+4.17	+2.14	+2.00	+2.41	+0.57	-0.17	-
35.6 - 0.3	7/07/78	KP	22"	-	-	+10.19	+5.24	-	+3.32	-	-	-	-	-	-	-
	8/16/78	W	5"	-	-	-	-	+5.32	-	+3.06	+1.12	+1.22	+0.98	-0.21	-1.73	-
	7/06/79	KP	16"	-	-	+11.55	+6.86	-	+4.86	-	-	-	-	-	-	-
	10/05/79	W	7"	-	-	-	-	+5.65	-	+3.44	+1.50	+1.37	+1.36	+0.20	-0.90	-
39.7 + 1.5 (GL 2290)	8/05/78	W	5"	-	-	+4.17	-	+0.87	-	-0.72	-2.46	-2.60	-2.85	-3.42	-4.08	-
	7/27/79	W	5"	-	-	+5.76	-	+1.94	-	+0.51	-1.46	-1.61	-1.81	-2.31	-2.29	-
	8/30/79	W	5"	-	-	+5.82	-	+1.88	-	+0.30	-	-1.61	-1.91	-	-	-
	4/18/80	W	5"	-	-	+5.62	-	+1.74	-	-0.01	-1.77	-1.84	-1.98	-2.73	-3.49	-
39.9 - 0.0	7/07/78	KP	22"	-	-	+9.21	+4.42	-	+2.54	-	-	-	-	-	-	-
	8/16/78	W	5"	-	-	+10.41	-	+4.61	-	+2.64	+0.83	+0.69	+0.48	-0.37	-1.91	-
	10/05/79	W	6"	-	-	-	-	+5.58	-	+3.42	+1.57	+1.44	+1.34	+0.41	-0.60	-
42.3 - 0.2	11/21/78	W	5"	-	-	-	-	+7.78	-	+4.64	+1.44	+1.32	+1.61	+0.24	-0.79	-1.28
	7/05/79	KP	16"	-	-	-	+8.38	-	+5.05	-	-	-	-	-	-	-

Table 2 (Con't)

OBJECT	DATE	System	beam	[1.25]	[1.65]	[2.3]	[3.45]	[3.6]	[4.6]	[4.9]	[8.7]	[10]	[11.4]	[12.6]	[19.5]	[23]
45.5 + 0.1	11/21/78	W	5"	-	-	+8.41	-	+4.89	-	+3.19	+1.46	+1.26	+0.90	+0.59	-0.36	+0.34
75.3 - 1.8	7/01/79	KP	11"	-	-	-	+6.09	-	+3.81	-	-	-	-	-	-	-
127.8 + 0.0	10/10/75	KP	-	-	-	+7.47	-	+2.24	-	+0.26	-	-1.47	-	-	-	-
(GL 230)	10//75	KP	-	-	-	-	-	+0.3	-	-	-1.5	-	-	-	-	-
	12/29/80	W	5"	-	-	+8.32	-	+3.51	-	+1.44	-0.35	-0.63	-0.48	-1.71	-2.95	-3.76
	1/07/81	W	5"	-	-	+7.76	-	+3.01	-	+0.90	-0.94	-1.03	-0.78	-2.22	-3.4	-
HIGH GALACTIC LATITUDE OH/AFGL SOURCES																
235.3 + 13.1 (GL 1274)	6/11/78	W	5"	-	-	+3.51	-	+1.88	-	+0.83	+0.18	-0.99	-1.56	-1.46	-3.09	-3.39
334.8 + 50.1	6/12/78	W	5"	-	-	+3.53	-	+2.25	-	+1.55	+0.16	-0.44	-0.88	0.85	-1.96	1.90
(GL 1686)	5/16/79	W	5"	-	-	+2.49	-	+1.48	-	+0.99	-0.54	-0.95	-1.88	-1.68	-2.64	-

Table 3: Physical Properties of OH/IR Sources*

OH Source Number	V_{LSR} Km s^{-1}	V Km s^{-1}	S_L^I $x10^{-22}$	S_H^I Wm^{-2}	NKD Kpc	GCD Kpc	K-L	Mean 11.4	IR PERIOD days	OH PERIOD days
18.8 + 0.4	13	29	27.5	17.1	1.3	8.8	1.54	-0.20	—	—
23.1 - 0.3	35	30	17.0	13.0	3.0	7.3	4.34	+0.63	—	—
24.7 + 0.3	42	40	17.0	12.6	3.4	7.1	4.61	+0.67	—	—
26.2 - 0.6	72	42	36.8	14.9	5.2	5.8	4.98	+0.51	1330	1295
26.4 - 1.9	28	24	5.0	9.5	2.2	8.1	3.51	+0.28	540	—
27.3 + 0.2	51	25	28.0	14.0	3.9	6.8	4.52	+0.64	—	—
28.7 - 0.6	46	34	6.7	6.6	3.5	7.1	2.62	+0.05	640	—
30.7 + 0.4	67	35	12.4	10.4	4.9	6.3	6.07	+0.81	1140	918
32.0 - 0.5	76	40	21.8	7.1	5.5	6.1	3.88	+1.23	—	—
35.6 - 0.3	78	28	20.2	13.8	6.2	6.1	4.82	+0.74	—	—
39.7 + 1.5	20	32	43.8	66.2	1.3	9.0	3.74	+0.32	—	—
39.3 - 0.0	149	29	10.4	10.3	7.7	6.4	5.30	+0.50	770	—
42.3 - 0.2	61	29	11.4	20.8	4.6	7.3	3.87**	+0.92	1650	817
45.5 + 0.1	36	35	8.0	6.0	2.5	8.4	3.52	+0.09	720	—
127.8 + 0.0	-55	22	57.2	35.4	3.9	12.8	4.93	+0.87	—	—

* V_{LSR}, V, S_L^I, and S_H^I from Bowers, 1978b; IR and OH Periods from Engels, 1982.

** [illegible] 1982

Figure Captions

Figure 1. The galactic distribution of our sample of "in-plane" sources as a function of ℓ_{II} and NKD. The sources in the first quadrant have a large range of NKD's (1.3-7.7 Kpc) along the Scutum arm of the galaxy. Their GCD's range from 6-9 Kpc. OH 127.8+0.0, with a GCD of 13 Kpc, is the lone anti-center source.

Figure 2. Two proto typical OH/IR stars, IK Tau and VX Sgr compared with the high latitude anonymous OH/IR stars OH 235.3+18.1 and OH 334.0+50.1

Figure 3. Sepctra of 15 OH/IR stars in the galactic plane arranged in order of increasing near kinematic distance showing the tendency of the infrared colors and the 11.4 μm silicate absorption optical depth to become large as NKD increases. OH 28.7-0.6 appears too blue and has too small an 11.4μm optical depth for its apparent NKD.

Figure 4a). Mean observed K-L as a function of NKD for OH/IR stars in Table 3. Vertical bars indicate color variations observed in this study and by Engels (1982). Lines labelled .13, .26, and .39 give the reddening E(K-L) in mag Kpc^{-1} for A_V = 2, 4, and 6 mags respectively. Solid circle indicates K from Engels (1982).

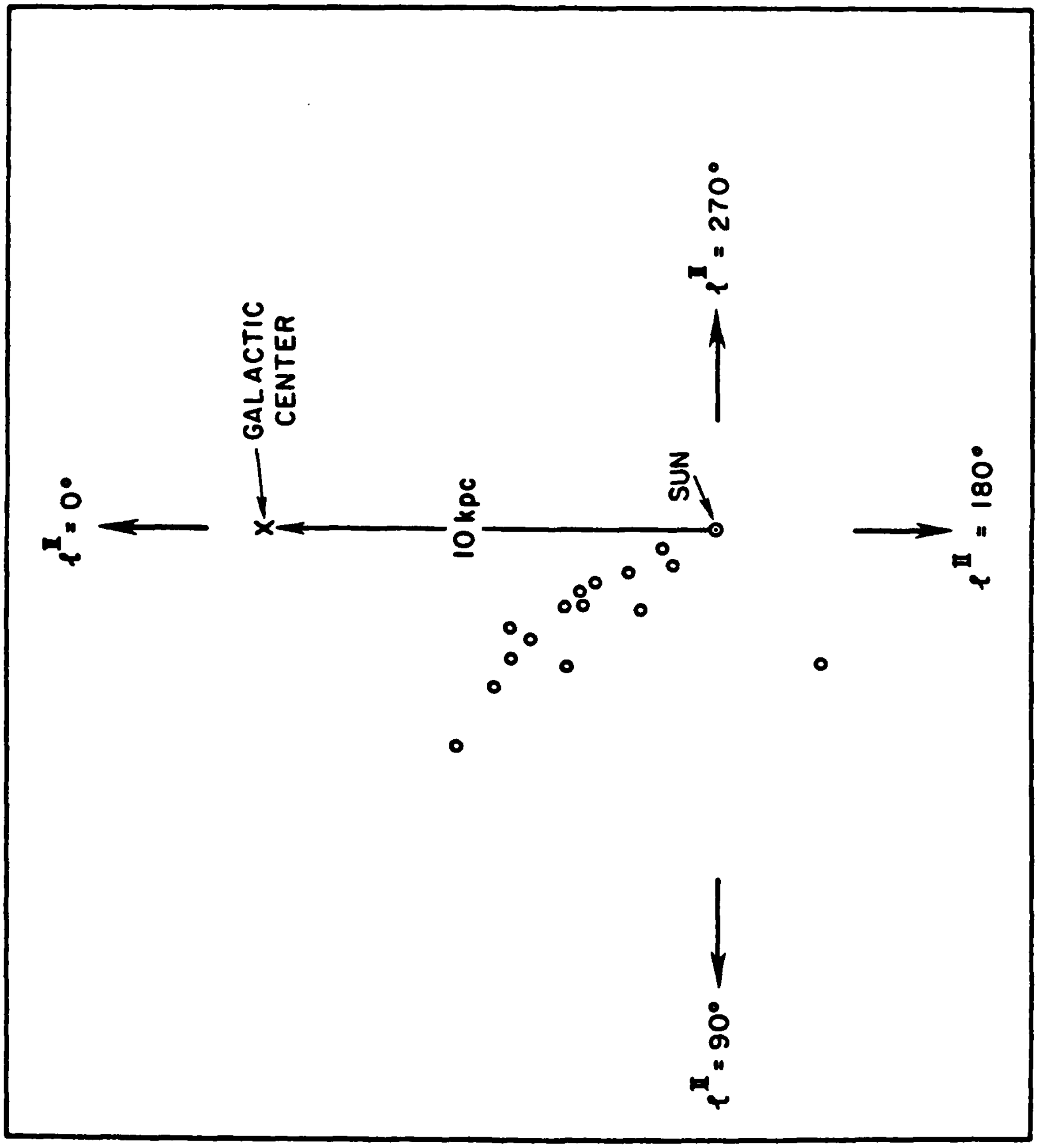
Figure 4b). The quantity K-[19.5] as a function of NKD for OH/IR sources in Table 3. Lines give E(K-[19.5]) in mag Kpc^{-1} for A_V = 2, 4 and 6 mag. Kpc^{-1}. Solid circle indicates K from Engels (1982).

Figure 4c). The quantity $\tau_{11.4}$ as a function of NKD for the sources in Table 3. Lines give $\tau_{11.4}$ per Kpc for A_V = 2, 4, and 6 magnitudes Kpc^{-1}. Vertical bars indicate observed range of variations.

Figure 5a). Absolute K magnitude as a function of NKD for the sources in Table 3. Closed circle indicates K from Engels (1982).

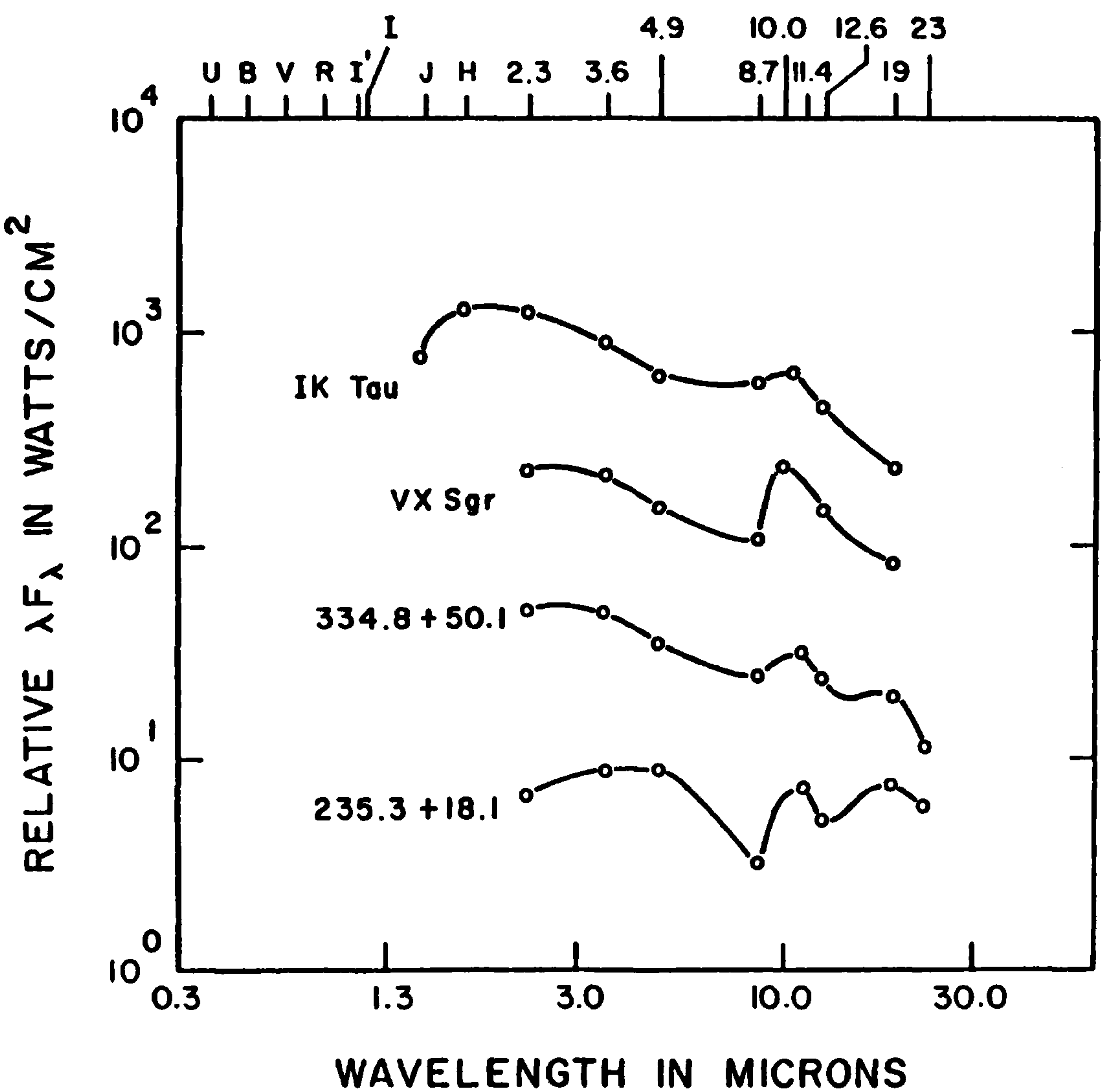
Figure 5b). The quantity ΔV_{OH} as a function of NKD for the sources in Table 3.

Figure 5c). Infrared bolometric luminosity as a function of NKD for the sources in Table 3. As would be expected for a sensitivity limited search, there are no low luminosity representatives at the largest distances.



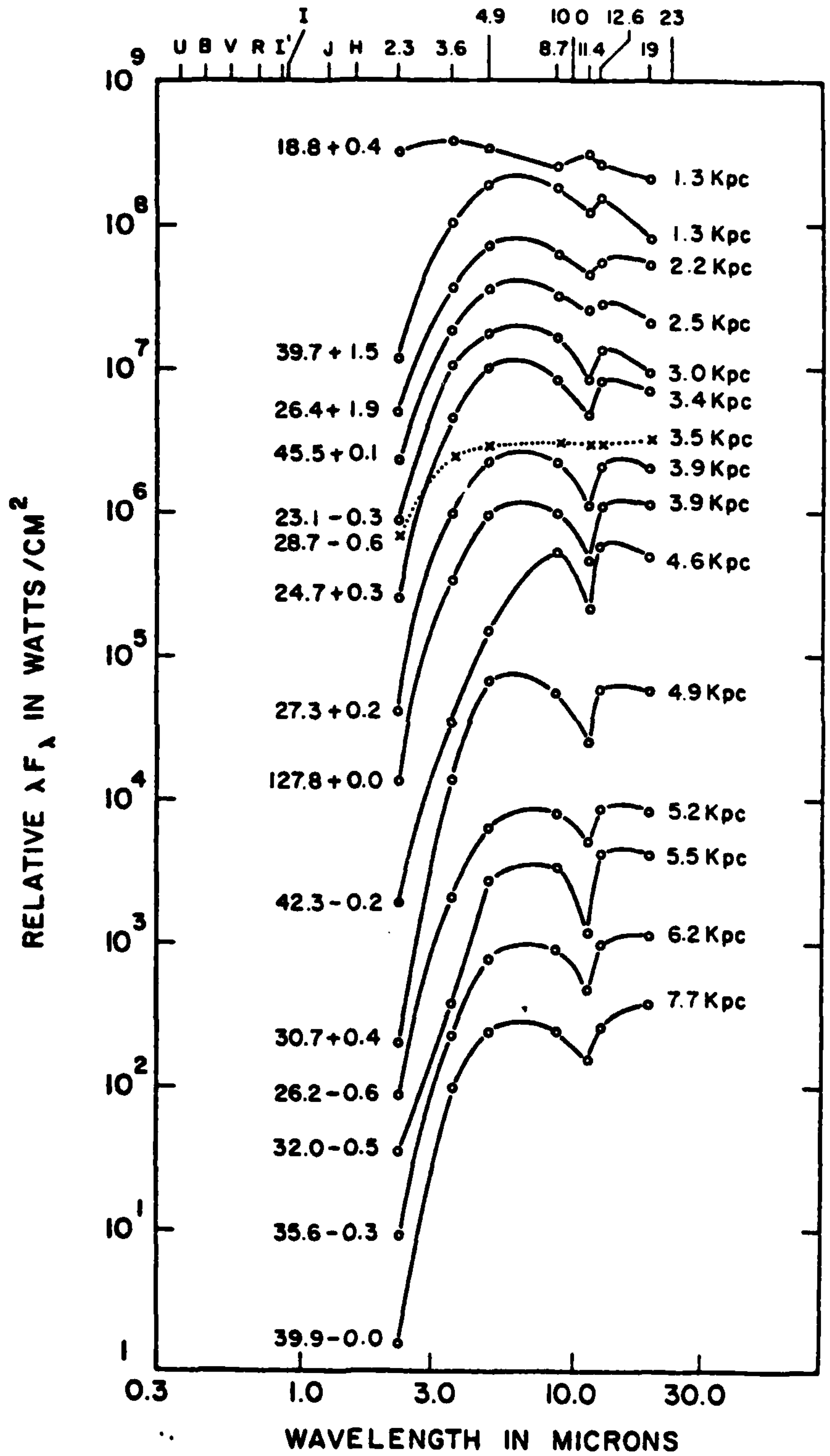
$\ell^{II} = 0°$
GALACTIC CENTER
10 kpc
SUN
$\ell^{II} = 270°$
$\ell^{II} = 180°$
$\ell^{II} = 90°$

Figure 1



I
U B V R I' J H 2.3 3.6 4.9 8.7 10.0 11.4 12.6 19 23
10^4
10^3
10^2
10^1
10^0
RELATIVE λF_λ IN WATTS/CM^2
IK Tau
VX Sgr
334.8 + 50.1
235.3 + 18.1
0.3
1.3
3.0
10.0
30.0
WAVELENGTH IN MICRONS

Figure 2



I
4.9
10.0
12.6
23
U B V R I' J H 2.3 3.6
8.7 11.4 19
RELATIVE λF_λ IN WATTS/CM²
WAVELENGTH IN MICRONS
0.3
1.0
3.0
10.0
30.0
18.8+0.4
39.7+1.5
26.4+1.9
45.5+0.1
23.1-0.3
28.7-0.6
24.7+0.3
27.3+0.2
127.8+0.0
42.3-0.2
30.7+0.4
26.2-0.6
32.0-0.5
35.6-0.3
39.9-0.0
1.3 Kpc
1.3 Kpc
2.2 Kpc
2.5 Kpc
3.0 Kpc
3.4 Kpc
3.5 Kpc
3.9 Kpc
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4.6 Kpc
4.9 Kpc
5.2 Kpc
5.5 Kpc
6.2 Kpc
7.7 Kpc

Figure 3

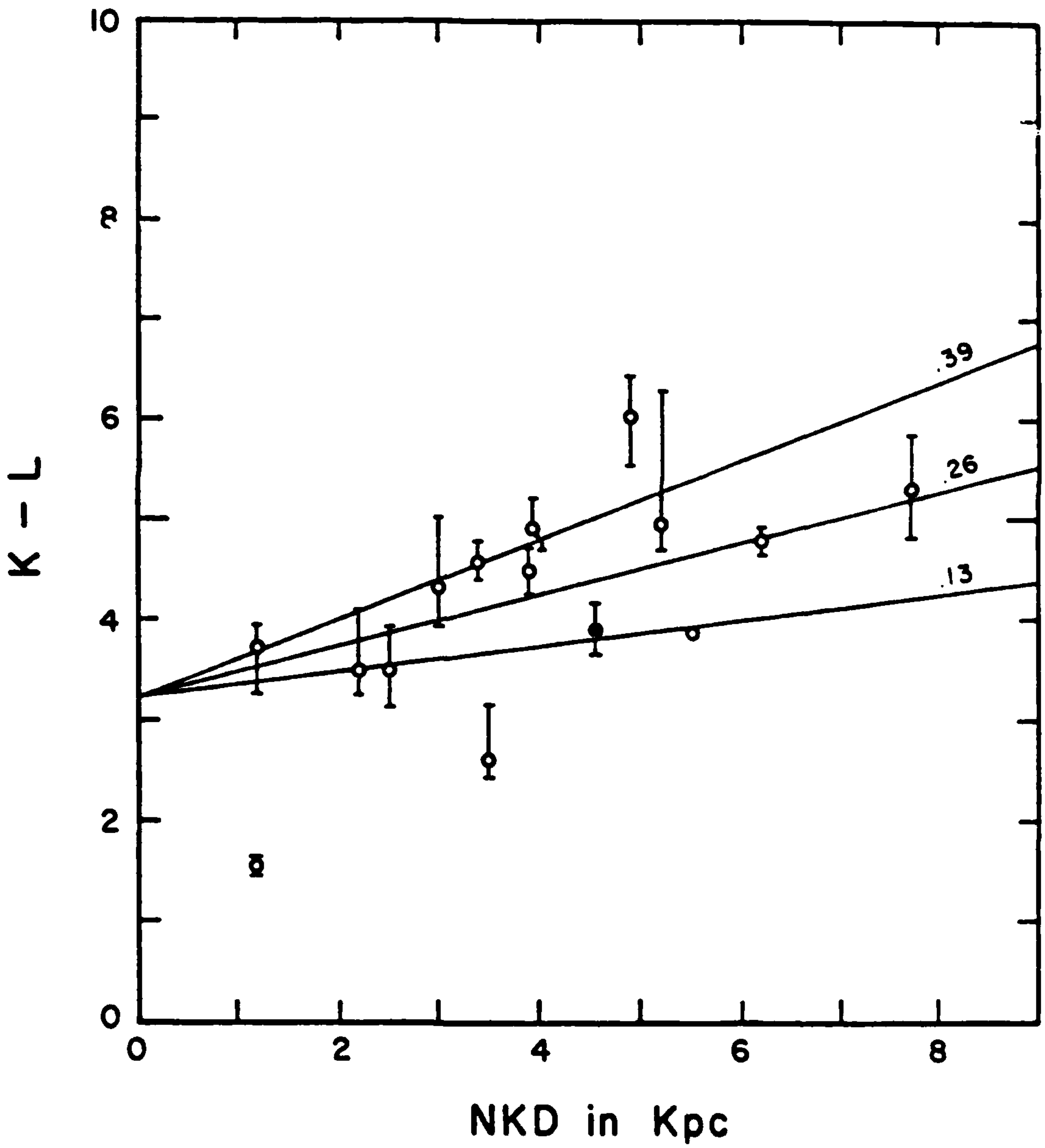

Figure 4a

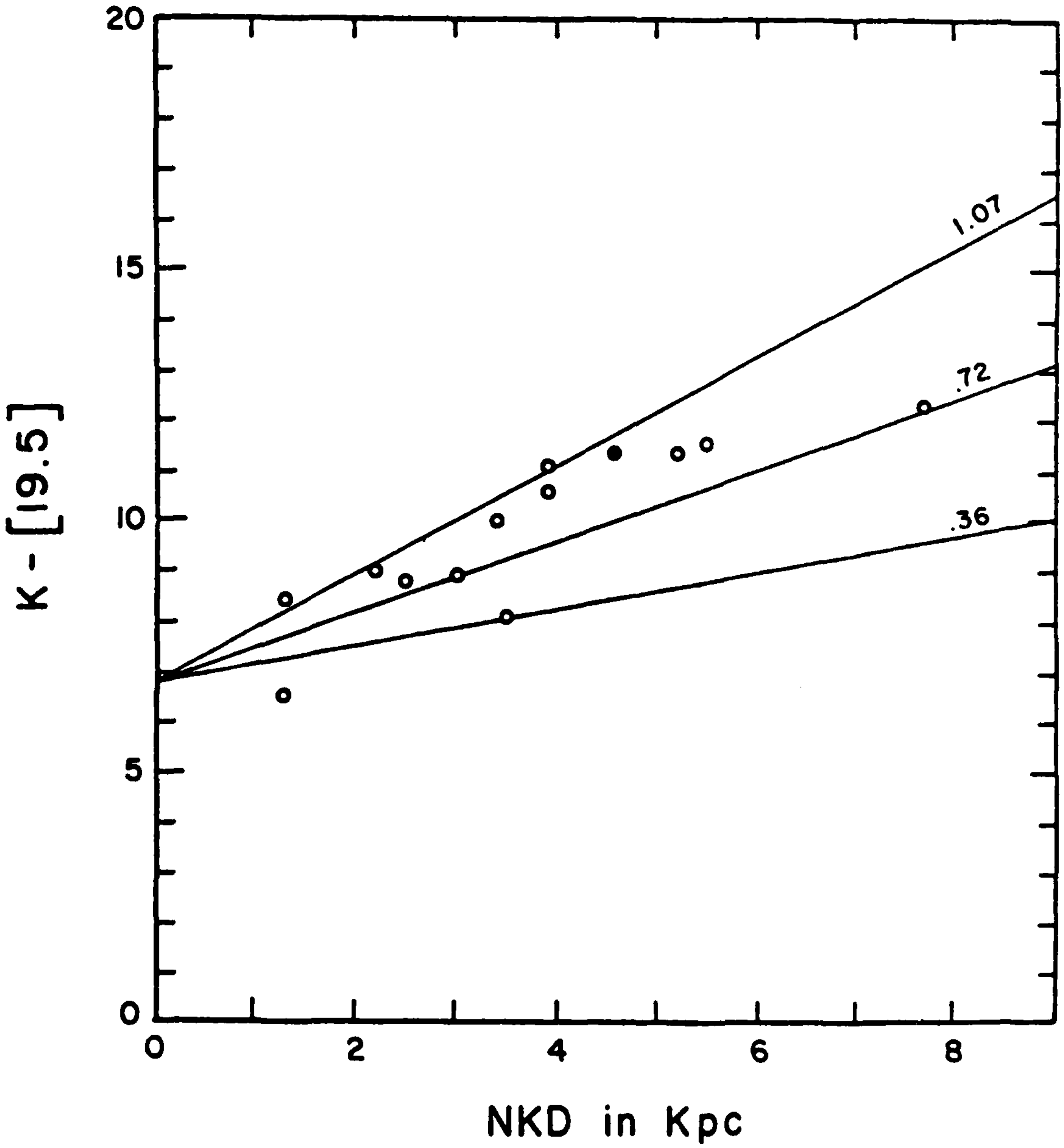

Figure 4b

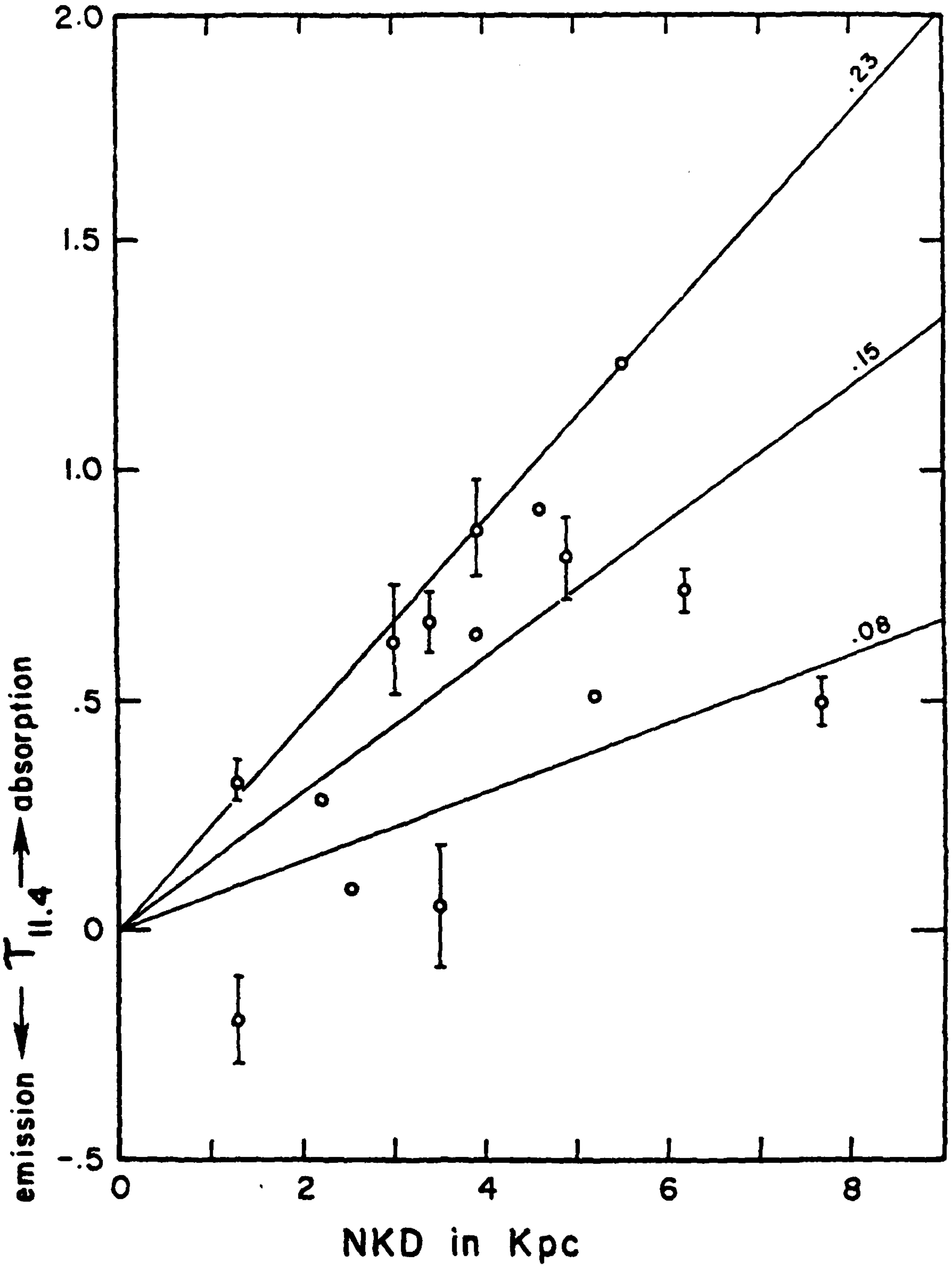
2.0
1.5
1.0
.5
0
-.5
0
2
4
6
8
NKD in Kpc
emission ← $\tau_{11.4}$ → absorption
.23
.15
.08

Figure 4c

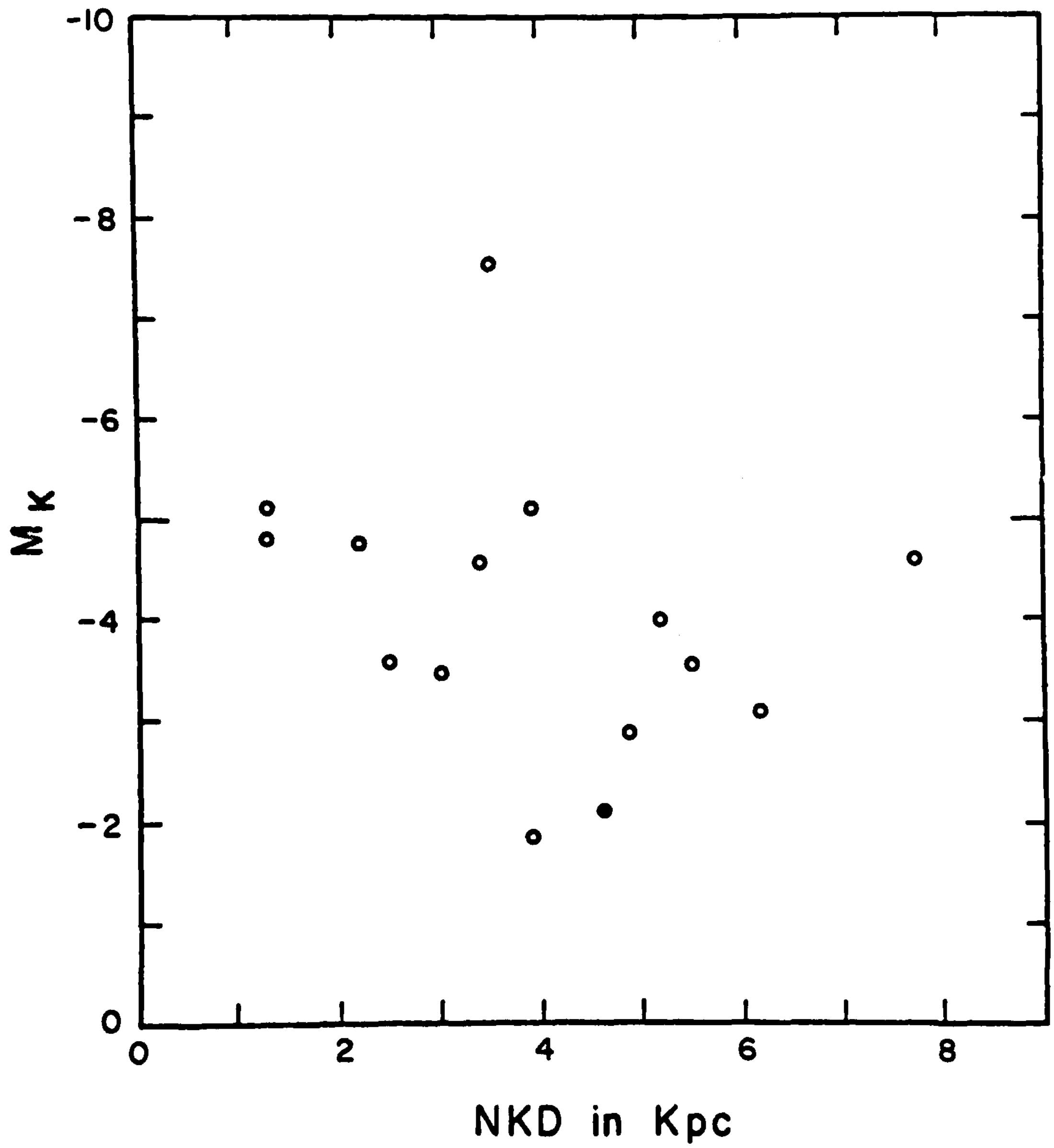

Figure 5a

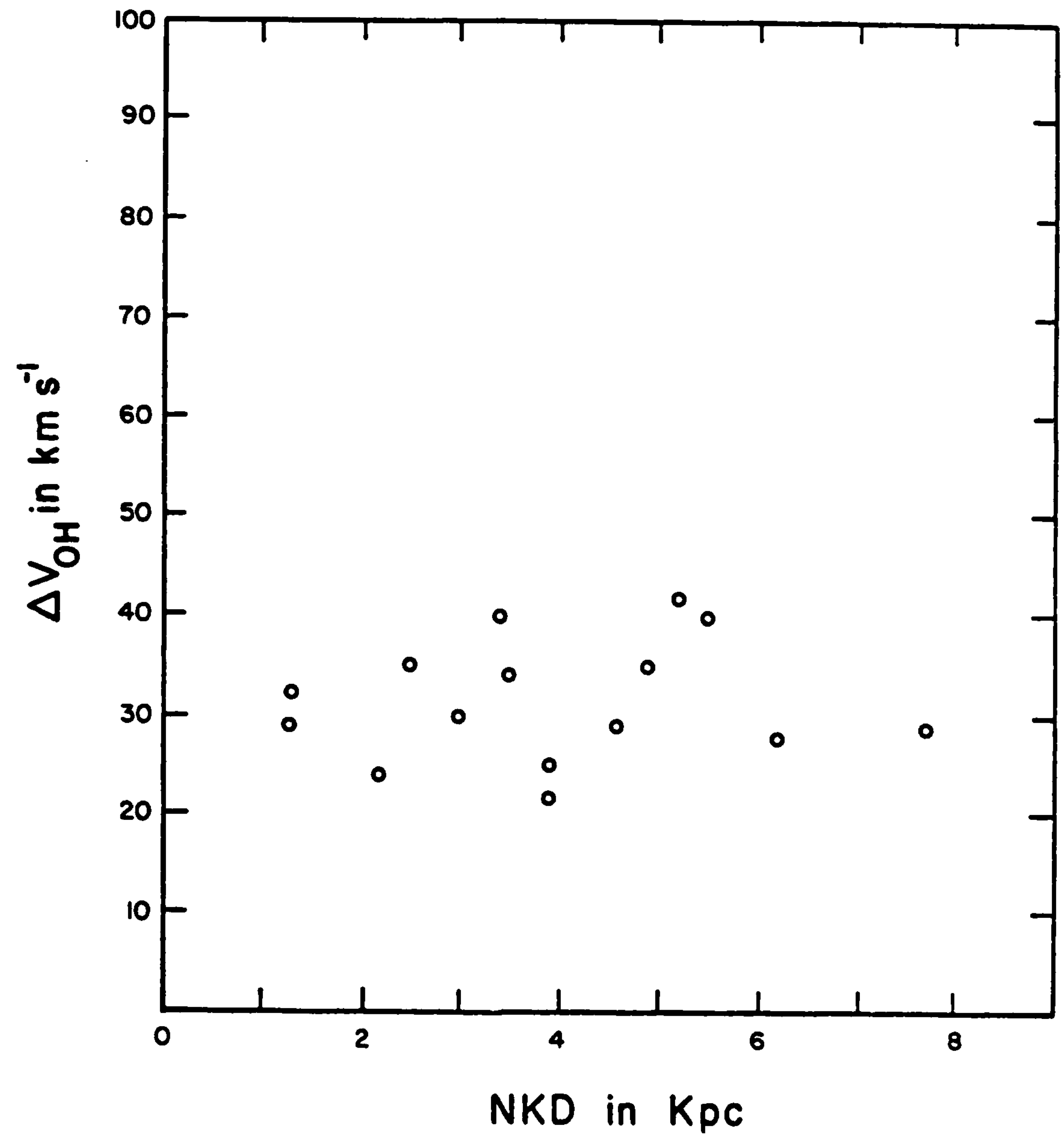

Figure 3b

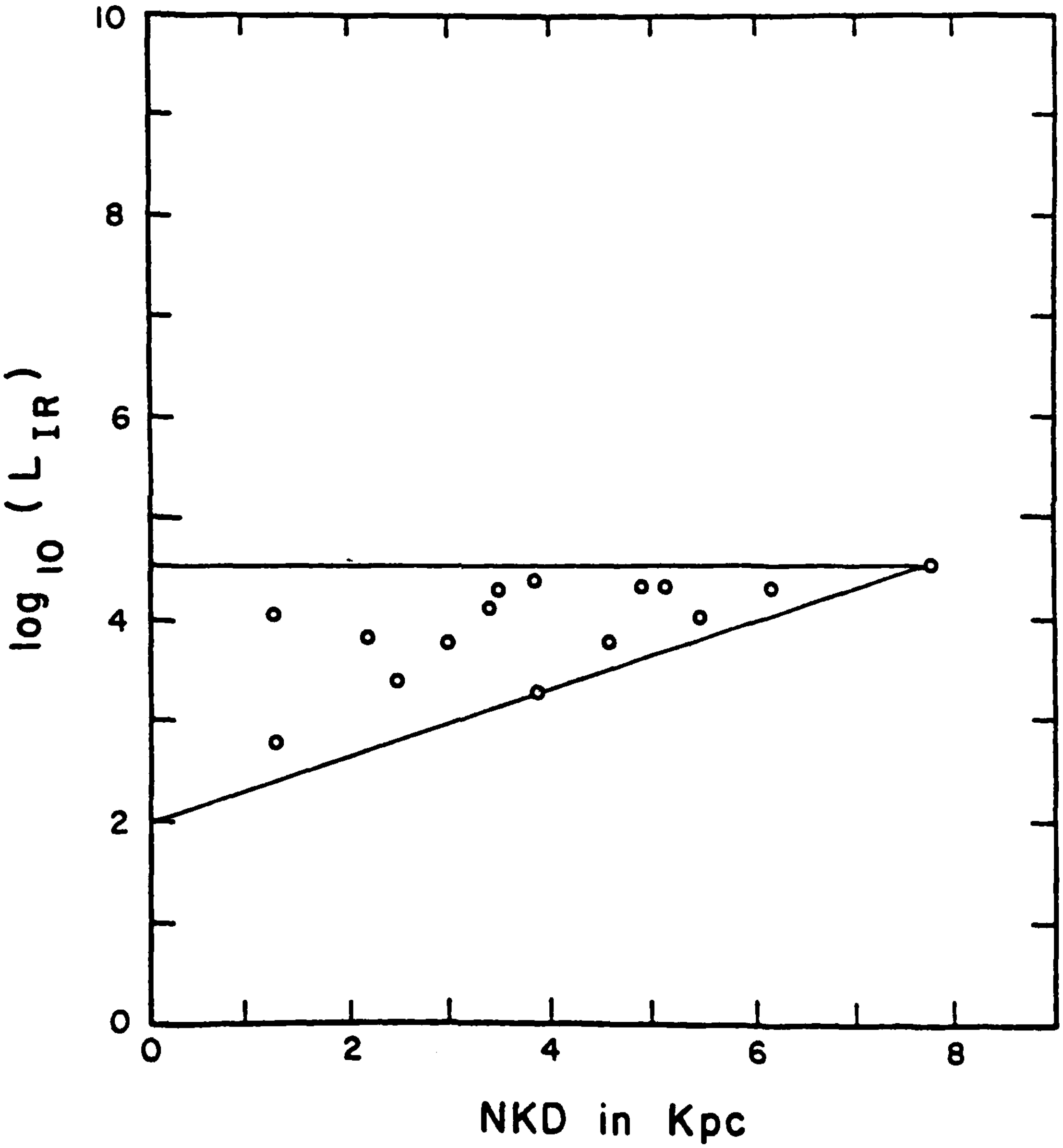

Figure 5c

END

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